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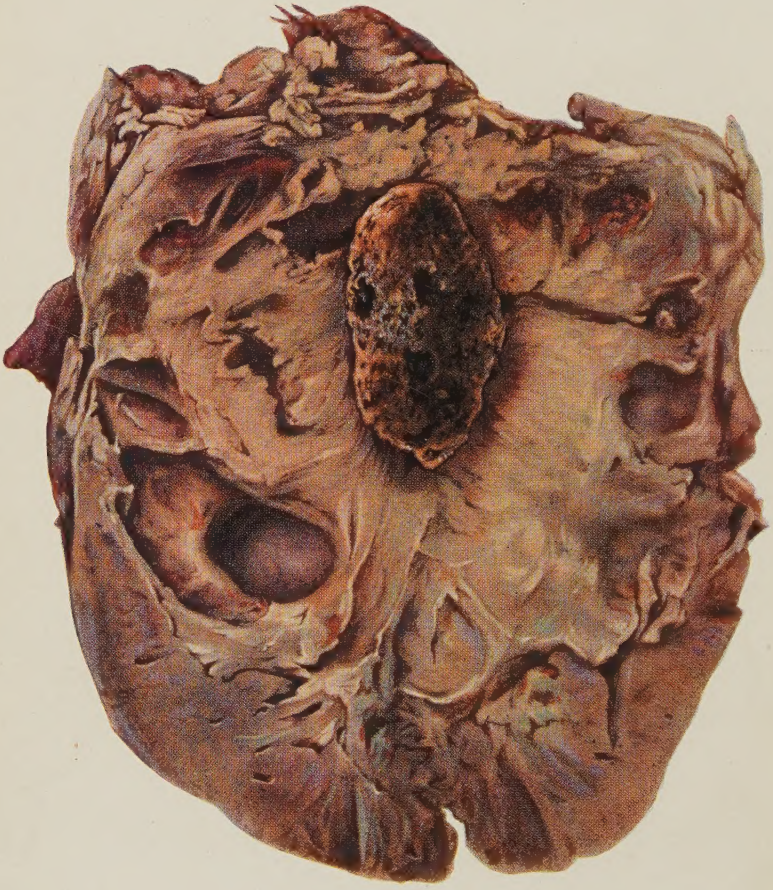

Renal calculus and pyelitis. Kidney almost completely disorganized. Nephrectomy. (Author's case.)

Genitourinary Diseases and Syphilis

BY

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THIRD EDITION, REVISED AND ENLARGED

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TO THE MEMORY

OF

MY OLD TEACHER AND FRIEND

DR. ALEXANDER J. C. SKENE

IN RECOGNITION OF HIS BRILLIANT ABILITIES AS A SURGEON
AND IN AFFECTIONATE REMEMBRANCE OF HIS
PERSONAL QUALITIES AS A MAN

THIS WORK IS DEDICATED

PREFACE TO THIRD EDITION.

Since the publication of the last edition many advances in the department of genitourinary diseases have been made, and the knowledge of syphilis has made greater progress than during the preceding four hundred years during which the disease has been known and studied.

In this short period the cause of the disease, the *Spirochæta pallida,* has been discovered, cultivated, and inoculated, the Wassermann reaction has made possible the diagnosis of syphilis in its latent state, and the discovery of salvarsan has given us a second remedy which is equal and in some respects superior to mercury, in destroying the organism upon which the disease depends.

In the last five years the preliminary treatment before prostatectomy and the care of the patient after the operation, together with a clearer understanding of the indications for the suprapubic or perineal approach, have served to reduce still more the death rate in this class of cases.

The introduction of indigo-carmin and phenolsulphonphthalein as tests of renal capacity affords an additional guide in estimating the safety of operation in cases of suspected kidney insufficiency, and the introduction of improved instruments for the examination and treatment of the posterior urethra has added to our knowledge of local changes at that point.

The treatment of bladder tumors is apparently about to be made more hopeful, through the application of the high-frequency current and more extensive bladder resections, and it remains only for time and further experience to demonstrate the value of these recent methods.

The author desires to express his thanks to his friends in Berlin, Surgeon-major Curt Roscher, for assisting in the preparation of the chapters on syphilis; Prof. Ludwig Pick, for the microscopic specimens kindly furnished; Professor Braun, of the Friedericshain Hospital, for many valuable points on surgical technique; Dr. Hans Wossidlo, for demonstrations of the posterior urethroscope, and to Drs. Frank, Rumpel, Levin, Goldbach, Wendriner, Bockenheimer, and Joseph, for many kindnesses shown him when in Berlin during the summer of 1911.

32 Schermerhorn Street,
Brooklyn-New York.

PREFACE.

In the past ten years no branch of surgery or medicine has made greater progress than the department of genitourinary surgery. In that short period of time, the treatment of acute and chronic gonorrhea has been removed from mere empiricism and placed upon a scientific and rational basis. This has been accomplished through investigations, whose results have given us a definite knowledge of the micro-organisms concerned, and the pathological changes in the urethral tissues which their presence excites.

The whole subject of chronic seminal vesiculitis, with its relation to sexual neurasthenia, and the ever-present danger of lurking infection, has been clearly demonstrated. It is less than ten years since the cystoscope came to be of practical use, and out of its development grew the various instruments for collecting the urine from each kidney separately, in this way stimulating a greater interest in the subject of renal surgery.

While the operations for stone in the bladder are as old as civilization itself, the improvements in the technique of lithotomy, and a clearer comprehension of the indications for each form of operation, are matters of very recent growth. Ten years ago the cases of hypertrophied prostate in old men were without remedy, after the failure of the catheter to alleviate the urgent symptoms, but today the operations of prostatectomy, castration, and Bottini's operation have opened a way of relieving the suffering and prolonging life.

The above-mentioned advances are only a few of the steps in the progress of this important branch of surgery.

In this little volume the author has endeavored to present, in a concise form, the present *status* of genitourinary diseases and syphilis. At the same time he has endeavored to keep in mind the needs of the practitioner, whose opportunities for seeing such cases may be infrequent, and to consider the questions of diagnosis, prognosis, and treatment in such a way that the book may be of practical use in these matters.

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Brooklyn-New York.

CONTENTS.

DISEASES OF THE PENIS.

PAGE

CHAPTER I.—Phimosis. Hypospadias. Stricture of the Meatus. Balanoposthitis. Herpes Progenitalis. Papillomata. Cancer of the Penis 1

DISEASES OF THE URETHRA AND ITS ADNEXA.

CHAPTER II.—Anatomy of the Urethra 22
CHAPTER III.—Acute Urethritis 28
CHAPTER IV.—Posterior Urethritis 55

COMPLICATIONS OF ACUTE GONORRHEA.

CHAPTER V.—Peracute Urethritis. Severe Burning on Urination. Retention of Urine. Balanitis. Phimosis. Paraphimosis. Folliculitis. Cowperitis. Inguinal Adenitis. Chordee. Epididymitis. Gonorrheal Rheumatism. Edema. Gonococcus Vaccine .. 62
CHAPTER VI.—Chronic Urethritis 76

INFLAMMATIONS OF THE PROSTATE.

CHAPTER VII.—Anatomy of the Prostate. Secretion of the Prostate. Acute Prostatitis. Chronic Prostatitis 124

DISEASES OF THE SEMINAL VESICLES.

CHAPTER VIII.—Acute Seminal Vesiculitis. Chronic Seminal Vesiculitis. Tuberculous Vesiculitis 146

STRICTURE OF THE URETHRA.

CHAPTER IX.—Spasmodic Stricture. Organic Stricture. Treatment of Stricture by Surgical Operation. Extravasation of Urine. Retention of Urine 160
CHAPTER X.—Urinary Fever. Care of Urethral Instruments 197

DISEASES OF THE BLADDER.

CHAPTER XI.—Cystitis. Bacteriuria. Tumors of the Bladder 205
CHAPTER XII.—Vesical Calculus. Cystoscopy. Enuresis in Children 224

DISEASES OF THE PROSTATE.

CHAPTER XIII.—Senile Hypertrophy of the Prostate 280
CHAPTER XIV.—Operative Treatment of Hypertrophied Prostate 302
CHAPTER XV.—Tuberculosis of the Prostate 349

DISEASES OF THE KIDNEYS.

PAGE

CHAPTER XVI.—Movable Kidney. Pyelitis. Hydronephrosis. Pyonephrosis. Renal Calculus. Tuberculosis of the Kidney. Tumors of the Renal Parenchyma. Operations on the Kidney 354

DISEASES OF THE TESTICLES.

CHAPTER XVII.—Ectopy of the Testicle. Malignant Disease. Tuberculosis. Syphilis 416

HYDROCELE, HEMATOCELE, AND VARICOCELE.

CHAPTER XVIII.—Hydrocele. Hematocele. Varicocele 430

CHANCROID AND ITS COMPLICATIONS.

CHAPTER XIX.—Chancroid. Complications 446

SYPHILIS AND ITS LESIONS.

CHAPTER XX.—Syphilis 463
CHAPTER XXI.—Chancre. Abortion of Syphilis After Infection 478
CHAPTER XXII.—Secondary Syphilis. Alopecia. Skin Eruptions, or Syphilides 489
CHAPTER XXIII.—Tertiary Stage of Syphilis. Syphilis and Irritation. Malignant Syphilis. Immunity in Syphilis 499
CHAPTER XXIV.—Inherited Syphilis. Syphilis and Marriage. Diagnosis of Syphilis. Prognosis of Syphilis 512
CHAPTER XXV.—The Wassermann Reaction 528
CHAPTER XXVI.—Treatment of Syphilis. Therapeutics of Syphilis 538

IMPOTENCE AND STERILITY.

CHAPTER XXVII.—Impotence. Sterility 563

List of Genitourinary Instruments Required for Office Use 581
Printed List of Instructions 582
Appendix 585
Index 595

LIST OF ILLUSTRATIONS.

FIG.		PAGE
1.	Renal calculus and pyelitis. (Colored.)	Frontispiece
2.	Clamp for circumcision	3
3.	Beard's clamp for circumcision	3
4, 5, 6, and 7.	Beck's operation	7
8.	Papillomata—venereal warts. (Author's case.)	13
9.	Epithelioma of penis showing nests of cells	15
10.	Carcinoma of penis. (Author's case.)	16
11.	Neglected carcinoma of penis. (Author's case.)	17
12.	Incision dividing scrotum into two halves and exposing corpus spongiosum, urethra, corpora cavernosa, and triangular ligament	18
13.	Corpus spongiosum containing urethra dissected away from corpora cavernosa, cut through and hanging down at lower angle of the wound	19
14.	Charred stumps of corpora cavernosa after separation from pubes by burning through them with Paquelin cautery	20
15.	Operation as completed. Urethra sutured into wound, with sound introduced through it	21
16.	Wax cast of the normal urethra	22
17.	Section through bladder, urethra, and testicle	23
18.	Section through corpora cavernosa and corpus spongiosum	24
19.	Bladder and urethra laid open to show the floor	25
20.	Cross-section of urethra, showing Littré's glands	26
21.	Simple or non-gonococcic urethritis	29
22.	Acute gonorrhea	32
23.	Gonorrheal conjunctivitis	33
24.	Acute gonorrhea. Prodromal stage. Clump of desquamated cylindrical epithelium, with colonies of gonococci growing between them. Original drawing from microscopic specimen	Facing 34
25.	Acute gonorrhea. Ascending stage. Pus-cells filled with gonococci. Original drawing from microscopic specimen	Facing 34
26.	Pus-cells containing group of gonococci	35
27.	Acute gonorrhea. Stage of decline. Desquamated squamous epithelium, with colonies of gonococci growing on them and pus-cells. Original drawing from microscopic specimen	Facing 36
28.	Gonorrheal shred. Squamous epithelium and a few pus-cells, held together by mucus. Gonococci have disappeared. Original drawing from microscopic specimen	Facing 36
29.	Frank's irrigating dilator, for the anterior urethra	49
30.	Valentine's irrigator	49
31.	Ultzmann's syringe	59
32.	Paraphimosis complicating gonorrhea	63
33.	Periurethral abscess, beginning as a folliculitis. (Author's case.)	64
34.	Horand-Langlebert suspensory bandage	67
35.	Gonorrheal rheumatism	71
36.	Diagram of a cross-section of the urethra	77
37.	Diagram of a section of the urethra	79
38.	Beginning stricture	80
39.	Shred from a case of gonorrhea of long standing	81
40.	Otis urethrometer	83
41.	Diagram showing method of detecting deep infiltration in chronic urethritis, with bougie à boule or urethrometer	84
42.	Diagram showing impossibility of recognizing superficial infiltration, involving mucous membrane alone, by means of bougie à boule or urethrometer	84
43.	Ultzmann's brush apparatus	86

FIG. PAGE

44. Guyon's syringe 87
45. Steel sound with van Buren curve 89
46. Roof of urethra 92
47. Galvanocaustic needle and handle 93
48. Secretion of prostatorrhea. Catarrh of prostatic ducts containing only epithelium, cylindrical and squamous. Original drawing from microscopic specimen ..... Facing 98
49. Secretion of prostatorrhea. Large numbers of bacteria, epithelial cells, and a few pus-cells. Original drawing from microscopic specimen ..... Facing 98
50. The Guyon sound 101
51. Frank's posterior dilator 102
52. Rectal and urethral electrodes 103
53. Urethroscope with electric light 104
54. Urethroscopic picture of a normal urethra 105
55. Urethroscopic picture of soft infiltration of the mucous and submucous tissues 107
56. Secretion spatula, or cannula 108
57. Urethroscopic picture of hard infiltration of the submucous tissues ... 109
58. Wossidlo's irrigation urethroscope for the posterior urethra 111
59. Swinburne's urethroscope for the posterior urethra 111
60. Normal prostatic secretion. Lecithin bodies abundant, granular phosphates, an occasional leucocyte, an amyloid body, and a few squamous cells from urethra or bladder. Original drawing from microscopic specimen ..... Facing 124
61. Normal secretion obtained by massaging the prostate and vesicles. Lecithin bodies abundant, a few spermatozoa, and an occasional leucocyte. Original drawing from microscopic specimen .... Facing 124
62. Section of normal prostate with amyloid bodies 124
63. Böttcher's crystals 125
64. Acute prostatitis 128
65. Section of prostate and urethra 129
66. Abscess of prostate ruptured into urethra 133
67. Secretion from chronic gonorrheal prostatitis, containing pus-cells and gonococci, extra- and intra- cellular. Original drawing from microscopic specimen ..... Facing 138
68. Secretion from chronic gonorrheal prostatitis. Large amount of pus; many mononuclear cells; no organisms. Original drawing from microscopic specimen ..... Facing 138
69. Diagrammatic representation of prostatic secretion 140
70. Arzberg's rectal psychrophore 144
71. Prostate and seminal vesicles 146
72. Microscopic examination of material expressed from seminal vesicles and prostate 147
73. Ampulla of vas and seminal vesicle 148
74. Ampulla of seminal vesicle 149
75. Cross-section of normal seminal vesicle 150
76. Spermatozoa 151
77. Purulent spermatocystitis 153
78. *a*. Normal seminal vesicles and prostate. *b*. Chronic seminal vesiculitis without perivesicular infiltration. *c*. Chronic seminal vesiculitis with perivesicular infiltration. *d*. Prostate irregularly enlarged from chronic prostatitis 155
79. Showing the point of the director maintained at the apex of the right seminal vesicle, while the scalpel is passing along the groove preparatory to incising the organ 157
80. Linear stricture 161
81. Annular stricture 162
82. Changes behind a stricture 163
83. Flexible bougie à boule 165
84. Metal bougies à boule 166
85. Filiform whalebone guides 166

FIG. PAGE
86. Stricture of urethra and hypertrophied bladder 167
87. Stricture of the bulbomembranous urethra and false passage 169
88. Sound perforating anterior wall of urethra at bulbomembranous junction 170
89. False passage 171
90. Various directions which false passages may take 172
91. Kollmann's anteroposterior dilator 174
92. Kollmann's dilator for the anterior urethra 174
93. Tunneled sound 176
94. Gouley's tunneled catheter 176
95. Otis urethrotome, as modified by Rand 178
96. Maisonneuve's urethrotome 179
97. Rand's tunneled sound 181
98. Gouley's catheter-staff 181
99. Tunneled knife 182
100. Gorget 182
101. Rand's staff introduced over a filiform guide to face of the stricture .. 183
102. Rand's knife introduced over filiform guide, preparatory to cutting stricture 184
103. External urethrotomy. Wheelhouse operation 185
104. Wheelhouse staff 186
105. Small tenaculum for retracting urethral wound in external urethrotomy 186
106. Arnott's grooved probe 187
107. Gouley's beaked bistoury 187
108. Straight steel sound 188
109. Extravasation of urine into tissues of penis and scrotum 192
110. Ulceration of urethra with extravasation of urine behind a stricture .. 193
111. Formation of a sacculation in a hypertrophied bladder 210
112. Multiple saccular diverticula of bladder 211
113. Tying catheter in the bladder 218
114. Instruments used in cystitis 219
115. Mandril for introducing a Pezzer catheter 220
116. Janet-Frank syringe 220
117. Benign papilloma of bladder 230
118. Benign bladder tumor 231
119 and 120. Carcinoma of bladder 232, 233
121. Operating cystoscope of Nitze 238
122. Diagrammatic representation of bladder and peritoneal fold 240
123. Multiple phosphatic calculi. (Author's case.) 243
124. Multiple phosphatic calculi, complicating hypertrophied prostate. (Author's case.) 243
125. Mulberry calculus removed by suprapubic cystotomy. (Author's case.) 244
126. Glass bottle covered with incrustations. (Author's case.) 244
127. Mulberry calculus, removed from boy of 16 years. (Author's case.) .. 244
128. Vesical calculus. (Author's case.) 245
129. Same split in halves. (Author's case.) 245
130. Vesical calculus, removed by suprapubic cystotomy. (Author's case.) . 246
131. Multiple calculi of bladder. (Author's case.) 247
132. Thompson's searcher for vesical calculus 249
133. Searching for stone lying in the postprostatic pouch 250
134. Nitze's observation cystoscope 250
135. The lithotrite opened in the median region of the bladder 252
136. Maneuver for grasping the calculus 253
137. Maneuver for grasping fragments 254
138. Accidental grasping of mucous membrane of bladder 255
139. Bigelow's lithotrite 256
140. Bigelow's evacuator 256
141. Lithotomy-staff 257
142. Lithotomy-knife 258
143. Lithotomy-forceps 258
144. Blizard's probe-pointed knife 258

FIG. PAGE
145. Incision through the urethra and prostate in lateral lithotomy 259
146. Lithotomy-scoop 260
147. Suturing the bladder in two layers 262
148. Guyon double tube for drainage of the bladder after suprapubic cystotomy 263
149. Bilharzia embryo 265
150. Urological table for cystoscopy, urethroscopy, and irrigating dilatations 267
151. Nitze's observation cystoscope 268
152. Nitze's double catheterizing cystoscope with attachment for irrigation of bladder 270
153. Posterior boundary of trigone and blood-vessels. Normal bladder ... 272
154. Orifice of ureter upon elevation. Normal bladder 272
155. Ureter expanding as urine issues from it 272
156. Ureter of old man dilated from calcareous degeneration 272
157. Cystitis. Blood extravasation and distended vessels 273
158. Trabeculated bladder 273
159. Villous papilloma of bladder 273
160. Papilloma from neck of bladder 273
161. Cauliflower-shaped papilloma of bladder 274
162. Hypertrophy of median lobe of prostate 274
163. Luy's segregator closed before introduction into bladder 275
164. Luy's segregator opened in bladder 276
165. Hypertrophied prostate. Adenomatous type 282
166. Prostatic hypertrophy. A large bladder 283
167. Prostatic hypertrophy. Bladder contracted and non-distensible 285
168. Prostatic hypertrophy. Enlargement of lateral and median lobes 286
169. Prostatic hypertrophy. Enlargement of the lateral lobes 287
170. Prostatic hypertrophy. Pedunculated middle lobe obstructing passage of a catheter. Diagrammatic 288
171. Hypertrophy of prostate 289
172. Mercier catheter coudé 299
173. Pezzer catheter 301
174. Senile hypertrophy of prostate 312
175. Prostatic hypertrophy. Considerable enlargement of both lateral lobes 313
176. Prostatic hypertrophy. Moderate enlargement of both lateral lobes .. 313
177. Perineal prostatectomy. 314
178. Prostate, weight 624 grains, removed by intra-urethral finger enucleation *en masse*. (Author's case.) 315
179. Prostate removed by intra-urethral enucleation with finger *en masse*. (Author's case.) 315
180. Flap of bladder, mucous membrane applying itself to sides of cavity, from which prostate has been enucleated either by perineal or suprapubic finger enucleation 316
181. Hypertrophied prostate after enucleation by perineal prostatectomy. Weight, 1420 grains. (Author's case.) 317
182. Hypertrophied prostate after enucleation by perineal prostatectomy. (Author's case.) 317
183 and 184. Post-mortem specimen of bladder after perineal prostatectomy. (Author's case.) 317
185. Prostatic hypertrophy. Bilateral enlargement 319
186. Prostatic hypertrophy. Marked enlargement of both lateral lobes, and globular intravesicular tumor from posterior commissure 319
187. Senile hypertrophy of prostate 320
188. Prostate weighing 6¾ ounces causing complete retention for five years. (Author's case.) 321
189. Rubber finger cot and shield for hand for use in prostatectomy 322
190. Suprapubic prostatectomy 323
191. Prostate removed by suprapubic prostatectomy. (Author's case.) 324
192. Freyer's suprapubic tube for bladder drainage after prostatectomy 324
193. Prostate removed by suprapubic prostatectomy. (Author's case.) 325
194. Exaggerated lithotomy position for Albarran-Young's prostatectomy . 328

FIG. PAGE
195. Line of incision for the Albarran-Young prostatectomy 329
196. Exposure of bulb, central tendon, and levatores ani 330
197. Enlarging with the fingers the space decollable inter-recto prostatique. 331
198. Young's prostatic retractor 332
199. Young's retractor introduced 333
200. Beginning the enucleation by separating the capsule from the prostate. 334
201. Enucleation of lateral lobes with finger while grasped with forceps ... 335
202. Enucleation of middle lobe by hooking finger over it and forcing it down into perineal wound 336
203. Prostate removed by perineal operations with Young's technique. (Author's case.) 337
204. Bottini's instrument, as modified by Freudenberg 339
205. Adenocarcinoma of prostate, showing epithelial nests 345
206. Differential diagnosis between senile hypertrophy and carcinoma of prostate 346
207. Adenocarcinoma of the prostate removed by suprapubic prostatectomy. (Author's case.) 347
208. Tuberculosis of prostate. Margin of caseation 350
209. Hydronephrotic kidney without much enlargement 364
210. Renal calculus. Pyelotomy. (Author's case.) 371
211. Renal calculus. Nephrectomy. (Author's case.) 371
212. Renal calculus. Nephrotomy with subsequent nephrectomy. (Author's case.) 372
213. Renal calculus removed by nephrolithotomy. (Author's case.) 373
214. Radiograph of renal calculus 374
215. Radiograph. Kink in ureter from prolapse of kidney 375
216. Radiograph showing hydronephrosis pyelography 377
217. Tuberculosis of kidney. Isolated foci in parenchyma which are beginning to break down. (Author's case.) 379
218. Tuberculosis of kidney. Isolated foci have broken down and formed cavities filled with pus, several of which communicate. (Author's case.) 380
219. Tuberculosis of kidney. Ulceration extending through wall of kidney. (Author's case.) 387
220. Tuberculosis of kidney. Ureter occluded. (Author's case.) 388
221. Hypernephroma of kidney. 391
222. Lines of incision for exposing kidney 397
223. Patient in position for exposure of the kidney 398
224. Diagram of section through region of loin at height of twelfth rib 399
225. Calculus of ureter of several years' duration. Removed by extraperitoneal route. (Author's case.) 401
226. Line of incision in nephrotomy for exploring pelvis of kidney. (After Albarran.) 402
227. Method of suturing a kidney 403
228. Deschamp's ligature carrier 404
229. Nephropexy. A grooved director is passed under fibrous capsule of the kidney, preliminary to stripping it off 405
230. Nephropexy. Albarran's method. The anterior part of the fibrous capsule is split in two halves 406
231. Reverdin needle 406
232. Nephropexy. Albarran's method. Sutures attached to stump of decorticated capsule 407
233. Testicle and its coverings 417
234. Normal testis 418
235. Tuberculous epididymitis; cheesy nodules 423
236. Hernia of fungus testis 424
237. Hydrocele. (Author's case.) 431
238. Vertical section of simple hydrocele 432
239. Hydrocele complicated by hernia 433
240. Electric hand-searchlight 434
241. Tapping a hydrocele 435

FIG. PAGE
242. Tapping a hydrocele. Direction of trocar at time of puncture; direction of trocar by evacuation 436
243. Chronic hydrocele complicated by hematocele from a fall. (Author's case.) 439
244. Varicocele. (Author's case.) 441
245. Section of chancroid 446
246. Section through the edge of a chancroid, showing Ducrey's bacillus ... 447
247. Chancroids of the prepuce. (Author's case.) 449
248. Taylor's flat-billed syringe for washing out the balanopreputial sac ... 455
249. Dorsal incision through prepuce to expose chancroids 456
250. Spirochæta pallida 465
251. Spirochæta refringens 466
252. Reflecting condenser for dark field 471
253. Tube and funnel necessary to use with oil-immersion objective 472
254. Arrangement for lighting the dark field with electric light 473
255. Fournier's syphilis curve 474
256. Section of a chancre (injected) 481
257. Condylomata of anus 492
258. Section through a papular syphilide 493
259. Large papular syphilide 495
260. Malignant syphilis. Pustular eruption. (Author's case.) 497
261. Endarteritis (artery from the fissure of Sylvius) 501
262. Gumma of the testicle 502
263. Gummata of the tongue. (Author's case.) 503
264. Ulcerating gumma of the ankle. (Author's case.) 504
265. Pustular syphilide (malignant syphilis). (Author's case.) 507
266. Rupial syphilide. (Author's case.) 509
267. Hutchinson's teeth 518
268 and 269. Later stages of the process after the dentine has been destroyed 519
270. Assmy's apparatus for intravenous injection of salvarsan 548
271. Anastomosis between the vas deferens and the head of the epididymis . 577

LIST OF FULL-PAGE PLATES.

PAGE

Renal calculus and pyelitis. (Author's case.) (Colored.) ..... Frontispiece

Acute gonorrhea. Prodromal stage. Clump of desquamated cylindrical epithelium, with colonies of gonococci growing between them. Original drawing from microscopic specimen ..... Facing 34

Acute gonorrhea. Ascending stage. Pus-cells filled with gonococci. Original drawing from microscopic specimen ..... Facing 34

Acute gonorrhea. Stage of decline. Desquamated squamous epithelium, with colonies of gonococci growing on them and pus-cells. Original drawing from microscopic specimen ..... Facing 36

Gonorrheal shred. Squamous epithelium and a few pus-cells, held together by mucus. Gonococci have disappeared. Original drawing from microscopic specimen ..... Facing 36

Secretion of prostatorrhea. Catarrh of prostatic ducts, containing only epithelium, cylindrical and squamous. Original drawing from microscopic specimen ..... Facing 98

Secretion of prostatorrhea. Large numbers of bacteria, epithelial cells, and a few pus-cells. Original drawing from microscopic specimen ..Facing 98

Normal prostatic secretion. Lecithin bodies abundant, granular phosphates, an occasional leucocyte, an amyloid body, and a few squamous cells from urethra or bladder. Original drawing from microscopic specimen ..... Facing 124

Normal secretion obtained by massaging the prostate and vesicles. Lecithin bodies abundant, a few spermatozoa, and an occasional leucocyte. Original drawing from microscopic specimen ..... Facing 124

I. Section of a normal prostate. II. Normal prostate. III. Catarrhal prostatitis. IV. Parenchymatous prostatitis. (Colored.) ..... Facing 126

I. Suppuration of lateral lobe of prostate. II. Chronic prostatitis. III. Hypertrophy of prostate (fibroid type). IV. Hypertrophy of prostate (adenomatous type). (Colored.) ..... Facing 126

Secretion from chronic gonorrheal prostatitis, containing pus-cells and gonococci, extra- and intra- cellular. Original drawing from microscopic specimen ..... Facing 138

Secretion from chronic gonorrheal prostatitis. Large amount of pus; many mononuclear cells; no organisms. Original drawing from microscopic specimen ..... Facing 138

Pyelonephritis. (Author's case.) (Colored.) ..... Facing 356

Renal calculus. Kidney parenchyma entirely destroyed. (Author's case.) (Colored.) ..... Facing 368

Renal calculus. Secreting parenchyma destroyed by formation of connective tissue. (Author's case.) (Colored.) ..... Facing 368

Tuberculosis of kidney. (Author's case.) (Colored.) ..... Facing 378

Pigmentary syphilide and alopecia. (Author's case.) (Colored.) ...Facing 490

Maculopapular syphilide. (Author's case.) (Colored.) ..... Facing 492

Relapsing eruption in late secondary syphilis, showing general distribution, asymmetry of arrangement, and ring form of lesions. (Author's case.) (Colored.) ..... Facing 496

Dry or atrophic tubercular syphilide. (Author's case.) (Colored.).. Facing 556

DISEASES OF THE PENIS.

CHAPTER I.

PHIMOSIS.

By the term phimosis is understood an abnormal narrowing of the opening of the prepuce, which prevents the retraction of the foreskin and causes the glans penis to be permanently covered.

Phimosis may be *congenital* or may be *acquired* in adult life.

In nearly all male children at birth the foreskin is long and is adherent to the glans. In early life these adhesions are very weak and are easily ruptured by erections of the penis or manipulation, and in the course of the first few years the preputial orifice becomes enlarged and the prepuce can be stripped back over the glans. If the adhesions are not ruptured early, they become firmer as they grow older, and prevent the complete retraction of the foreskin.

The *acquired* form of phimosis occurs in adults, and often results from the cicatricial contraction of the margin of the prepuce following the healing of a chancroid in this location.

Temporary phimosis often results from the swelling and edema of the prepuce which occurs in the course of an attack of gonorrhea or subpreputial chancroids.

As **direct results of phimosis** the following conditions are met with:—

(*a*) *Balanitis and venereal warts,* resulting from the maceration of the epithelium in the balanopreputial sac, from retention of smegma and urine. On account of the difficulty of retracting the prepuce proper cleanliness cannot be observed, and the tender mucous membrane is especially liable to persistent and recurrent attacks of inflammation. Proliferation of the epithelial cells occurs, and venereal warts grow luxuriantly.

(*b*) *Preputial calculi,* or concretions, form not infrequently, from a calcification of the smegma and the decomposition of the urinary salts.

(*c*) *Epithelioma of the penis* is strongly predisposed to by the continued irritation of the foreskin and retention of the secretions under it.

(*d*) *Arrested development of the penis* usually occurs in consequence of the malnutrition from which the organ suffers.

(*e*) *Premature erections and sexual excitement* are generally noted in young children affected with phimosis, and the continued irritation about the head of the penis often establishes a habit of *masturbation.*

(*f*) *Interference with the act of coitus,* often accompanied by premature ejaculation, is frequently complained of by adults affected with phimosis.

(*g*) *Liability to infection with syphilis or chancroidal poison* is invariably the case when the prepuce is long, even though it can be retracted, and Hutchinson points out that the circumcised Jew is less liable to contract syphilis than an uncircumcised person, because after circumcision the integument of the glans becomes horny, and is not liable to abrasions.

The remote results of phimosis are equally important, and often present great difficulties in the exact determination of their origin.

(*a*) *Retention or incontinence of urine,* especially in children, but sometimes in adults, is often caused by a spasmodic contraction of the cut-off muscle or an irritable bladder, induced by the irritation about the glans penis.

(*b*) *Hemorrhoids, prolapsus ani, hernia, and dilatation of the ureters and kidney pelves* often follow the prolonged and violent straining efforts which individuals affected with phimosis make, upon urinating, in order to overcome the resistance offered by a spasmodic stricture or a pinpoint opening through the prepuce. The susceptible nervous system of children renders them particularly liable to the above-mentioned difficulties and also to the following affections:—

(*c*) *Affections of the nervous system,*—spastic palsies, simulated hip-joint disease, muscular inco-ordination, and convulsions,—which are often observed in young children as reflexes from a tight or adherent prepuce, and a disappearance of these symptoms often follows circumcision.

(*d*) *Herpes præputialis* is another manifestation of the reflex action upon the nervous system and skin of the prepuce occasioned by the irritation of a long foreskin, even though it is possible to retract it over the glans.

TREATMENT.

On account of the manifold advantages offered by an absence of the foreskin, it would be well if Christian nations were to adopt the old Hebrew rite of circumcising all male children on the eighth day after birth. In this operation the foreskin is simply snipped off with one sweep of a knife, and the wound washed with a weak astringent antiseptic. The pain is slight, and an anesthetic is not required, nor would it be safe

to administer one, in so young a child. Hemorrhage is trifling, and there is but little risk of infection afterward.

Stripping back the foreskin and breaking up the adhesions is sometimes recommended, but is a very poor makeshift for circumcision, and there is always the danger of the prepuce being caught back behind the glans, and becoming swollen and constricted, causing *paraphimosis*.

Circumcision is the operation of choice, and may be performed in two ways:—

(*a*) **Circumcision with a Clamp.**—In this operation the clamp is applied to the foreskin immediately below the glans penis, and all the

Fig. 2.—Clamp for circumcision.

prepuce which projects beyond the clamp is severed with a knife or scissors. This incision simply cuts through the skin alone, and the mucous membrane lying next the glans is left intact and must next be trimmed off with the scissors. After this is done the cut edges of skin and mucous membrane are stitched together with interrupted sutures of catgut, and the operation is completed.

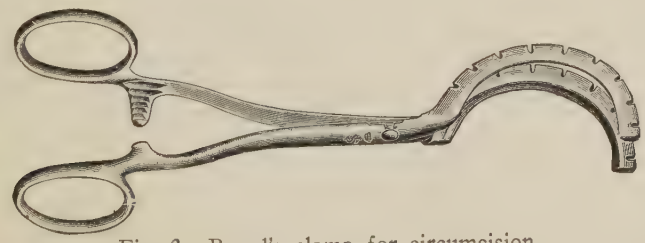

Fig. 3.—Beard's clamp for circumcision.

There are certain objections to this procedure. In applying the clamp, if too much traction is made on the foreskin, the skin of the proximal end retracts close up to the root of the penis after the incision is made, and leaves a gaping raw surface of mucous membrane to be covered. On the other hand, if too much foreskin is left, the glans remains covered by it and the object for which the operation was performed is not accomplished. Even when the incision is properly made the subsequent adjustment of skin and mucous membrane often induces a certain amount of tension and dragging upon the sutures, which interferes with the healing of the wound.

(*b*) **Circumcision by Dorsal Incision and Trimming off the Flaps.**—The surgeon stands upon the patient's left side and with a pair of

straight scissors makes an incision on the dorsum of the prepuce, cutting through skin and mucous membrane at the same time. The incision is carried up to the point three-eighths of an inch from where the mucous membrane is reflected upon the glans penis. A grooved director may be introduced under the foreskin if desired, to act as a guide for the scissors.

After the dorsal incision is made the two remaining flaps of skin and mucous membrane are trimmed off with curved scissors. This incision is carried around the penis on both sides, following the line of insertion of the mucous membrane at a distance of three-eighths of an inch from the glans.

The frenum is divided last, and its artery, together with the dorsal artery, and sometimes one or two smaller ones, are picked up and tied, and the sutures are introduced.

It is desirable to place the first suture on the dorsum of the penis, and the second suture stitches the remains of the frenum to the point of skin underneath it. These anchor the skin and prevent it from shifting, as it lies on the mucous membrane. The other sutures are then introduced, and usually three on a side will be found enough. Fine catgut is the best material, as it is absorbed, while if silk sutures are used much trouble is experienced in removing them.

The best form of dressing seems to be a piece of lint wet with an antiseptic solution and changed frequently, as any sort of permanent dressing is soon soaked with urine. The patient should remain quietly in bed or on a lounge, for a week, and may be then allowed to go about as usual.

Very recently a new form of operation has been devised with **Beard's clamp,** which has certain advantages.

By means of this clamp the flaps can be trimmed off even, and Schleich's infiltration of cocaine can be used as local anesthesia.

Technique.—A 4 per cent. cocaine solution is injected along the dorsum of the penis, and a dorsal incision through the skin and mucous membrane is made with scissors.

The flap thus formed is grasped with the clamp and cocaine injected along its outer edge.

The flap is then trimmed off with scissors, using the edge of the clamp as a guide.

The sutures are inserted through the skin and mucous membrane, the notches in the clamp serving as guides for placing them.

The clamp is then removed and the opposite side treated in the same way.

With regard to the anesthetic employed, some surgeons use cocaine injection by Schleich's infiltration method.

The objection to cocaine injected hypodermically in the older operations of circumcision with a clamp or by dorsal incision is, that the skin shrinks so much under the effect of the cocaine that landmarks are obliterated and the surgeon is apt to cut off too much skin and mucous membrane. The edema of the cellular tissue resulting from tying a rubber bandage around the root of the penis to prevent the too rapid absorption of the cocaine interferes with the healing of the wound afterward.

These objections seem to be removed by using Beard's clamp, and it would seem as though it might be a valuable adjunct in the operation.

On account of the objections to the use of cocaine, the author prefers to use a general anesthetic, and nitrous oxide is well adapted to the purpose.

HYPOSPADIAS.

Hypospadias is the most frequent malformation occurring in the penis, Rennes finding it once in every 300 French army recruits.

The deformity often exerts a depressing psychical influence on the individual's mind; the garments are soiled with urine, there is difficulty in expelling the stream of urine, and in doing so the patient assumes the squatting posture.

The scrotum, constantly wet with urine, becomes eczematous, and coitus is often difficult on account of the incurvation of the penis.

Fecundation is nearly always impossible, and in 100 cases of married hypospadiacs examined by Beck none were found to have children.

The forms in which hypospadias occurs are described by Treves as follows:—

1. The balanitic opening is at the side of the corona, the frenum is absent, and a hoodlike prepuce exists.

2. The penile urethra may open at any part of the under surface of the penis, and if the opening be far back nearly the whole of the penile urethra is absent so far as its floor is concerned.

3. Scrotal hypospadias.—Here the opening is at the junction of the penis and scrotum, or is on the perineal side of the scrotum.

In most cases the penis is small and deformed, and is held in a curved position by the rudimentary urethra on its under surface.

The operations of Dupuytren and Thiersch are best adapted to scrotal and marked examples of penile hypospadias.

In these operations a new canal is made by dissecting up flaps on

either side of the penis and building from them a new urethra, around a sound, which serves as a mold.

While the technique of these operations is not especially difficult, the subsequent healing is interfered with by the leakage of urine, with infection of the stitch-wounds, and primary union is the exception.

BECK'S OPERATION[1]

is based on the fact of the extraordinary distensibility of the urethra, which can be utilized for restoring either penile or balanic hypospadias.

Instead of forming a new urethra, the existing one is utilized by dissecting it free and dislocating it forward. As time elapses after the operation, the urethra becomes more elongated and adapts itself to the new position.

If the case is left untreated until adult life, the penis becomes short, wasted, curved, and often cannot be straightened.

It would naturally be supposed that, during erection after an operation, the short urethra would draw down the glans and a curvature of the penis would follow.

Beck's experience, however, in a number of cases shows that this does not follow, particularly when the operation is performed in childhood.

Technique.—A soft-rubber catheter or steel sound is introduced into the urethra, and an incision is made through the skin and fascia from the abnormal opening backward to the posterior third of the pendulous urethra.

A transverse incision is then made through the skin in the coronary sulcus, thus freeing the upper angles of the wound.

The urethra is then dissected in its whole length from its bed in the corpora cavernosa. The hemorrhage is but trifling.

The next step of the operation consists in forming a bed in the glans to receive the end of the loosened urethra.

(*a*) This may be done in two ways. The first method, which in general is to be preferred, is by forming two flaps, by making lateral incisions alongside of the groove in the glans. The end of the urethra is then placed in the wound-bed, covered with the flaps, and held in place with catgut sutures. (Figs. 4 and 5.)

(*b*) By the other method the glans is tunneled, by thrusting a narrow-bladed, straight bistoury through it from below upward. The incision is enlarged sufficiently so that the urethra can be drawn through it by means of a long, narrow forceps, and held in place by four catgut sutures. (Figs. 6 and 7.)

[1] New York Medical Journal, December 8, 1900.

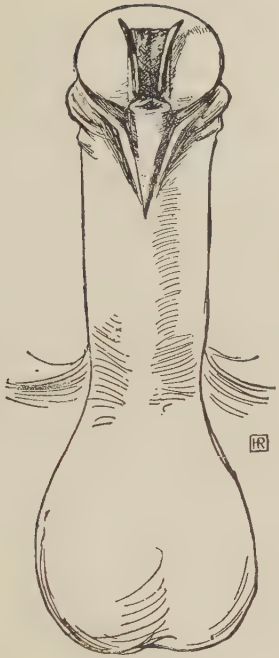

Fig. 4.

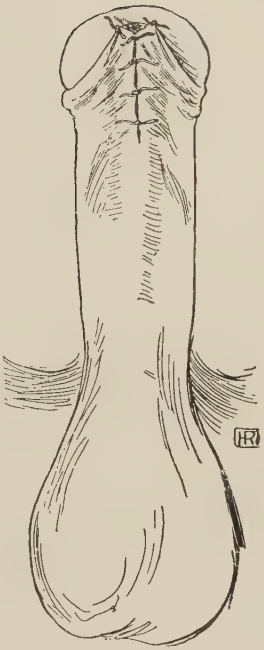

Fig. 5.

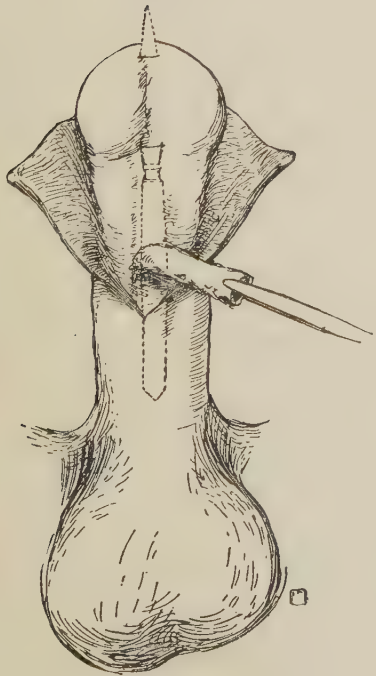

Fig. 6.

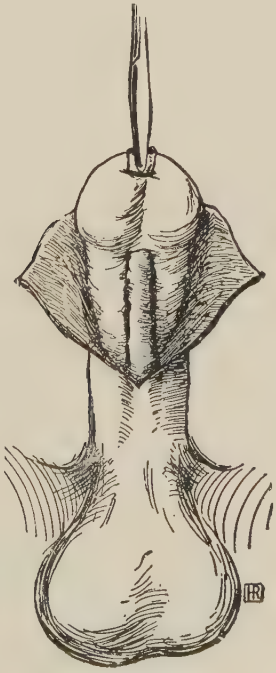

Fig. 7.

The after-treatment is very simple, and consists in bandaging the penis in iodoform gauze and keeping a wet dressing over the newly formed orifice.

In adults, after an operation, especially in the case of a penile hypospadias, a slight incurvation is noted during erections.

This is best treated by the introduction of large metal sounds, which are allowed to remain in place for a time. If the incurvation becomes considerable, longitudinal incisions are made alongside the urethra into the penis.

STRICTURE OF THE MEATUS.

The meatus differs very much in size. Usually it is large enough to admit a 28 or 30 sound, but often it is so small that only a 22 sound can be introduced, or it may even be pinpoint in size. Narrow meatus is usually a congenital deformity, but it sometimes occurs as a consequence of cicatricial contraction following a chancroid of the meatus.

SYMPTOMS.

Narrow meatus often gives rise to no symptoms and does not in itself require treatment. Not infrequently, however, it prevents a complete emptying of the urethra, during urination; a few drops of urine remain behind in the fossa navicularis, decompose, and cause a chronic inflammation of the mucous membrane.

The inflammatory process acts in a reflex way, inducing a spasmodic contraction of the cut-off muscle, with permanent or occasional retention of urine.

In cases of chronic urethritis, the presence of a narrow meatus interferes with the proper drainage of the urethra, and the irritation of the decomposing urine prevents the postgonorrheal lesions from healing. Some of these cases are cured by doing a meatotomy.

In every case where instrumentation of the urethra or bladder is required, as in litholapaxy, cystoscopy, urethroscopy, or sounding, if the meatus is too small to admit the instrument, it must be incised.

It is bad surgery to attempt to force an instrument through a narrow meatus; the pain caused is excessive and the meatus is liable to be torn, while the operation of **meatotomy** is very slight and without risk.

TECHNIQUE.

A rubber band is tied around the penis, to serve as a tourniquet.

A few drops of a 4 per cent. solution of cocaine are injected hypodermically into the frenum and the meatus incised with a straight, blunt-

pointed bistoury *on its floor,* sufficiently to admit a bulbous bougie, No. 30 French.

The fresh wound may then be stuffed with Schleich's glutol, a bandage applied, and the patient allowed to go about.

The patient should be instructed to pass a meatus sound three times a day, until the wound is healed. If this is not done, the cut surfaces will adhere and the opening close.

In very rare cases a severe hemorrhage follows meatotomy, due to wounding the artery of the frenum.

If it is entirely severed, the artery retracts and closes; but if only partially cut through, it continues to bleed. The hemorrhage may be controlled by passing a catheter through the meatus and making counter-pressure by firm bandaging around the end of the penis.

BALANOPOSTHITIS.

Balanitis consists in an inflammation of the mucous membrane covering the glans penis, and an inflammation affecting the mucous layer of the prepuce is termed posthitis. The inflammation of both surfaces usually exists simultaneously, and should be considered together.

Balanoposthitis cannot occur in an individual who has been circumcised, but the presence of a long and phimotic foreskin allows the retention of the natural secretion of smegma and a few drops of urine, which decompose and irritate the already macerated mucous membrane, lowering its power of resistance to germ infection.

Gouty and lithemic conditions and diabetes also render the patient extremely liable to develop inflammation of the mucous membrane underneath a long foreskin.

As a direct exciting cause it is probably necessary that micro-organisms of some sort must be inoculated, and for this reason a balanoposthitis often develops from contact with irritating vaginal secretions in coitus or the accidental introduction of pyogenic organisms from contact with the hands or clothing.

Chancre, gonorrhea, and chancroid are apt to be complicated by balanoposthitis as a result of mixed infection, when they occur in an individual having a long foreskin.

SYMPTOMS AND COURSE.

A mild form of balanoposthitis is liable to occur at frequent intervals unless the man with a long foreskin attends with scrupulous care to drawing it back and washing it, and the preputial sac, at frequent intervals.

If this is not done, a sense of heat and itching is noticed at the end of the penis; the mucous membrane becomes hyperemic, infiltrated, and eroded, and a creamy-yellow, purulent discharge, with an extremely offensive odor, is secreted from the mucous membrane of the preputial sac.

In *severe* cases the excoriations are extensive and well marked and the inflammation and edema are extreme; so that the whole prepuce becomes swollen. In this condition *gangrene* of the foreskin, either in part or as a whole, not infrequently takes place.

DIAGNOSIS.

The diagnosis of balanoposthitis presents but little difficulty, when the foreskin can be retracted and the glans inspected; but when phimosis exists the diagnosis is often perplexing.

If a microscopic examination of the discharge fails to reveal gonococci, but discloses numerous staphylococci, gonorrhea may be excluded.

Chancroid may be diagnosed by inoculating some of the preputial discharge upon the patient's thigh, and, if other chancroids are caused, it is probable that the original sore was a chancroid, although it is possible to cause sores resembling chancroids by the inoculation of staphylococci.

Chancre can be excluded by the absence of an indurated mass under the prepuce and the lack of the characteristic enlargement in the inguinal glands.

Epithelioma is often difficult to differentiate from the chronic form of balanoposthitis which affects middle-aged men; but epithelioma does not respond to local treatment, while balanitis improves quickly. In cases of doubt it is always in order to excise a small portion of the prepuce and subject it to microscopic examination to determine the question.

TREATMENT.

The essential points in the treatment are to keep the *parts clean and dry*. These indications can be met in the following manner:—

In the cases when the *prepuce can be retracted*, the balanopreputial sac should be washed out with a mild antiseptic solution, either bichloride (1 in 10,000 to 1 in 4000) or Thiersch's fluid. The parts should then be dried and covered with a dusting powder:—

℞ Pulv. amyli,
Pulv. zinci oxidi,
Pulv. talci .....āā ℥ij.

Or:—

℞ Hydrarg. chlor. mite ..... gr. xxx.
Acidi borici ..... gr. xv.
Acidi salicylici ..... gr. v.

In chronic cases, occurring in elderly men, subgallate of bismuth has a particularly good effect.

After applying the dusting powder the glans should be covered with a layer of cotton and the foreskin drawn forward into place. This dressing should be changed several times a day.

If the erosions are deep and extensive, their healing can be hastened by brushing them over with a 10 per cent. nitrate-of-silver solution before applying the dusting powder.

When *phimosis* exists and the *foreskin cannot be retracted,* a long flat-billed syringe should be used for washing out the balanopreputial sac, every few hours.

A few syringefuls of warm water and soap may be thrown in and followed by injecting bichloride solution (1 in 10,000) or Thiersch's fluid.

The edema and swelling of the parts may be mitigated by prolonged soaking in hot water.

If the balanitis occurs as a result of diabetes or a subpreputial chancroid, it may be necessary to relieve the tension by slitting up the prepuce on the dorsum in order to avert impending gangrene.

In all cases of chronic or relapsing balanoposthitis, in addition to local measures, attention should be directed to the diathetic conditions which prevent a permanent healing. If the individual is gouty or diabetic, a suitable regimen should be adopted, and the general health carefully looked after.

In obstinate cases of balanoposthitis, circumcision should be performed as soon as the acute symptoms have subsided. This is especially necessary in elderly men, who are at an age when epithelioma is liable to develop on the glans or under the prepuce from the prolonged irritation of the parts.

In diabetic patients the operation of circumcision should be avoided if possible and the danger of extensive gangrene following slight operations should be borne in mind. If any operative procedure is demanded, it is of the highest importance to get the patient's urine in good condition before operating.

HERPES PROGENITALIS.

This affection is characterized by the formation of groups of small vesicles upon an erythematous base and located on the skin or mucous surface of the prepuce.

The thin vesicles are easily ruptured, and leave small, round, shallow, punched-out ulcers, which heal spontaneously in a few days.

Unlike herpes zoster, herpes progenitalis is generally unaccompanied with pain. In exceptional cases, however, pain is felt, which is neuralgic in character and precedes the appearance of the eruption.

A urethral discharge is sometimes observed, and endoscopic examination shows a collection of vesicles located *within* the urethra.

Recurrence is a marked characteristic of herpes progenitalis, and it is the rule for patients to have several attacks a year.

ETIOLOGY.

Herpes progenitalis may be regarded as a reflex manifestation of some irritation of the nerves supplying the genitals, and is usually due to balanoposthitis, excessive coitus, or a long prepuce. Gouty and lithemic conditions are thought to predispose the patient to attacks of herpes.

DIAGNOSIS.

If the case is seen early, the appearance of the vesicles is unmistakable, and after they have ruptured the small, round, punched-out ulcers are quite characteristic.

The lymphatic glands in the groin are usually not affected, but in 1 case in 10 the inguinal glands are said to be enlarged in a chain, as in syphilis. (J. W. White.)

TREATMENT.

The herpetic lesions rapidly heal with cleanliness and the application of a simple absorbent dusting powder. Recurrent herpes progenitalis, which almost always occurs in connection with a long foreskin, can only be prevented by the operation of circumcision.

PAPILLOMATA.

Papillomata occurring about the head of the penis are frequently termed *venereal warts*. They are sometimes spoken of as *condylomata*, which is manifestly incorrect, as true condylomata are a manifestation of syphilis, and the papillomata have no connection with syphilis, but are of purely local origin.

Papillomata consist in warty growths, which are flat or often cauliflower-like excrescences, usually located in the coronary sulcus under a long prepuce. In structure they are a simple hypertrophy of the papillary layer, and are caused by the prolonged maceration and softening of the mucous surfaces under a long foreskin, occasioned by contact with irritating discharges from gonorrhea, chancroids, or balanoposthitis.

DIAGNOSIS.

Papillomata may be mistaken for the condylomata of syphilis or epithelioma. In syphilitic condylomata, however, other signs of specific

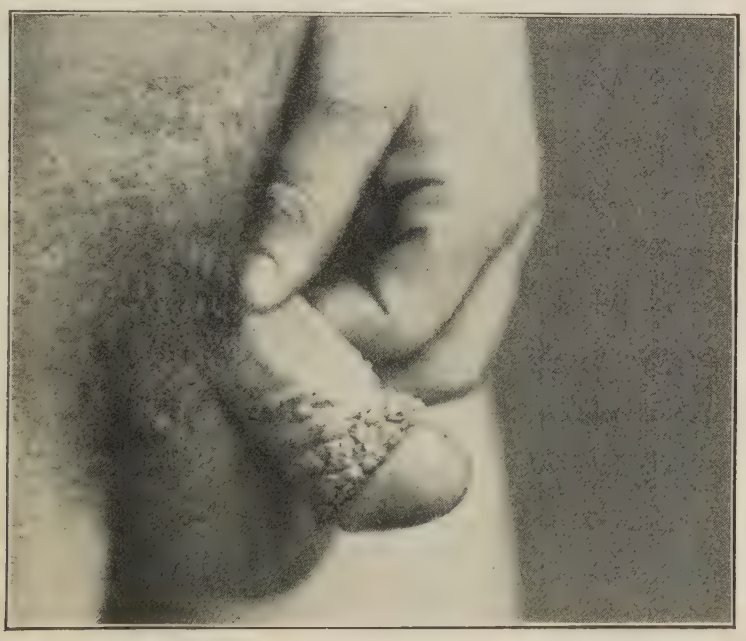

Fig. 8.—Papillomata—venereal warts. (Author's case, from Kings County Hospital.)

disease are always present; but epithelioma may be difficult to differentiate from simple papillomata, and every warty growth occurring about the glans penis in elderly men should be regarded with suspicion.

TREATMENT.

Small warts sometimes disappear if the parts are kept clean and covered with a dusting powder; but their disappearance is a matter of uncertainty, and always very slow. Operation is the best treatment, and should always be advised

As papillomata occur in consequence of a long foreskin, circumcision should be performed, and the warts which are not removed with the prepuce scraped off with a sharp curette. In order to prevent a recurrence, it is desirable to cauterize the bases with nitric or carbolic acid or the Paquelin cautery.

CANCER OF THE PENIS.

Malignant disease of the penis occurs almost invariably as epithelial carcinoma, and begins with about equal frequency on the inner surface of the prepuce or upon the glans.

According to Jacobson, its mode of commencement is varied, but it appears most frequently as (*a*) *a wart,* or *warty excrescence.* Sometimes, however, it makes its appearance as (*b*) *a small nodule,* or *knot of induration,* under the surface of the mucous membrane.

Again, epithelioma is observed occurring under the form of (*c*) *a superficial excoriation,* or *raw patch,* resembling the erosions found in balanoposthitis; or it may develop as (*d*) *an ulcer* resulting from the transformation of a chancroid or the breaking down of an old cicatrix, or sometimes from a crack or tear on the margin of a tight foreskin.

In cases of extreme rarity epithelioma of the penis develops from the *extension of the malignant process* outward from the urethra or upward from the scrotum.

ETIOLOGY.

Under the head of predisposing causes *age* plays an important rôle, and epithelioma of the penis is very rarely found except between the fiftieth and seventieth years.

The next most important predisposing cause is *phimosis.* Demarquay found that out of 59 cases of epithelioma of the penis, 42 had long and phimotic foreskins, and many authors have called attention to the fact that the circumcised Jews are almost entirely free from this disease.

Even though the glans be covered with a long foreskin, if the individual attends to the daily cleansing of the balanopreputial sac there is no opportunity for irritating secretions to be retained; but we notice that cancer of the penis almost always occurs in men in the lower walks of life, of neglectful and uncleanly personal habits.

Any condition which gives rise to a balanoposthitis, such as the retention of decomposed smegma and urine under a phimotic foreskin, particularly if aggravated by a gouty diathesis in the patient, excites a persistent and long-continued irritation. In an elderly person in course of time the simple inflammatory process undergoes a transition into

carcinoma of a polymorphous type, composed of large pavement-cells and small epithelial cells.

COURSE.

No matter in what form the disease had its origin, its course is one of extension at the edges, accompanied by ulceration and breaking down

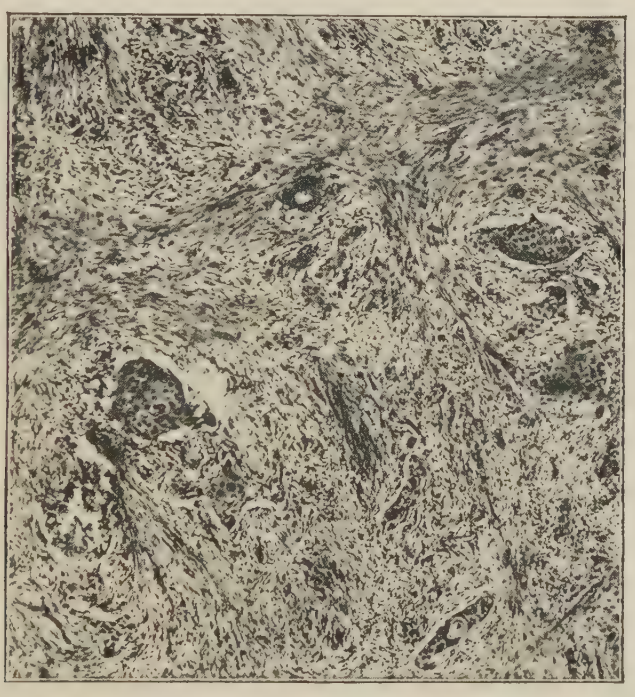

Fig. 9.—Epithelioma of penis showing nests of cells.

in the older parts, and in most cases this is attended by the formation of large vegetations, or fungosities, resembling a cauliflower in shape.

A thin fluid, of a most disgusting odor, which dries into scabs, is continually secreted.

As the cancerous process extends only by continuity, its advance through the corpora cavernosa is not rapid, but the lymphatics readily take up the infectious material, carry it to the glands in the groin, and these are usually involved quite early in the disease.

The inguinal lymphatic glands are often the seat of a mixed infection, if pyogenic bacteria have been conveyed to them through the lymphatics and cause them to become inflamed and suppurate.

DIAGNOSIS.

Every warty or papillomatous growth, or persistent erosion occurring on the glans penis, or inner surface of the prepuce, in an elderly person, should always be regarded with grave suspicion.

It is often difficult to differentiate simple papillomata or a chronic balanoposthitis from carcinoma, but the age of the patient, the long, protracted duration of the sore, together with a base which is hard, infiltrated, and immovable, and an edge which is hard and infiltrated, would point strongly in the direction of epithelial carcinoma. The

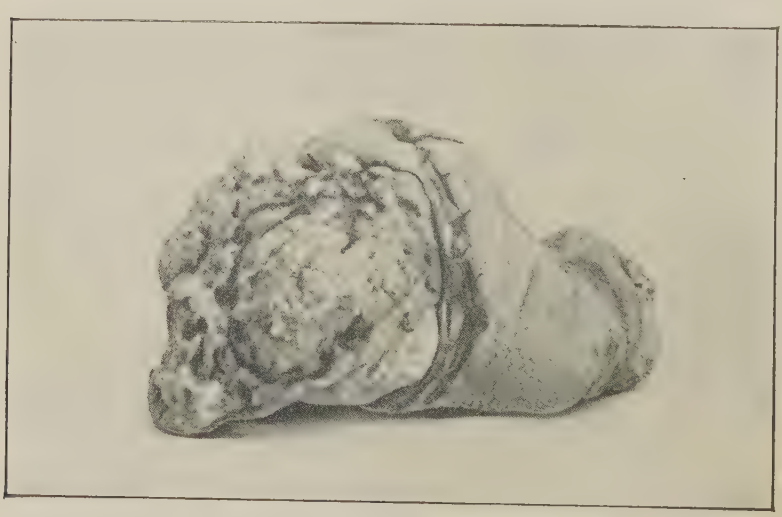

Fig. 10.—Carcinoma of penis. Amputation—a redundant prepuce removed by circumcision. Author's case.

diagnosis could be definitely determined by cutting a small piece from the growth and subjecting it to microscopic examination.

A gumma of the penis occurring in tertiary syphilis might be easily mistaken for epithelioma; but a few weeks' treatment with mercury and iodides would cause the gumma to disappear.

PROGNOSIS.

The prognosis of epithelioma of the penis is, of course, fatal without operation, and death occurs in from one to two years. If the disease is seen early and the growth removed by amputation of the penis and extirpation of the groin glands, the prognosis is good; but many cases come into the hands of the surgeon too late for a complete removal of all the foci of infection. Winiwarter reports 12 amputations, of which

5 remained permanently well, 1 died of the operation, and 6 had recurrences, 3 of which were in the stump and 3 in the glands.

TREATMENT.

As already indicated, complete removal of all deposits at the earliest possible moment offers the patient the only opportunity of saving his

Fig. 11.—Neglected carcinoma of penis, with involvement of inguinal glands. Author's case.

life, and the application of caustics only excites greater activity in the growth and is a waste of valuable time.

Two forms of operation are in use, and a selection depends upon the extent to which the inguinal glands and corpora cavernosa are involved.

OPERATIONS.

Amputation of the Free Portion of the Penis.—*Technique.*—A No. 20 French sound is introduced through the meatus into the bladder to indicate the position of the urethra.

A harelip-pin is thrust through both corpora cavernosa, at the root of the penis, to hold in place a rubber band, which is made to encircle the penis and act as a tourniquet.

The skin of the penis is then cut through with a circular sweep of the knife, and turned back an inch. The corpora cavernosa are divided,

Fig. 12.—Incision dividing scrotum into two halves and exposing corpus spongiosum, urethra, corpora cavernosa, and triangular ligament.

down to the corpus spongiosum, which, with the urethra, is left to project like a spout for an inch, before being cut through.

The tourniquet is then unloosed and at least four arteries will require ligation. The skin-flaps are sutured together, and the urethra stitched to the margins of the skin-flaps.

A soft-rubber catheter is tied in the bladder to prevent the urine from infecting the fresh wound.

Amputation of the Entire Penis.—This is a much more serious operation than the former, but is demanded in the case of extensive infiltration of the corpora cavernosa with cancerous deposit.

Technique.—The patient is placed in the lithotomy position, and a sound is introduced through the urethra into the bladder. An incision is

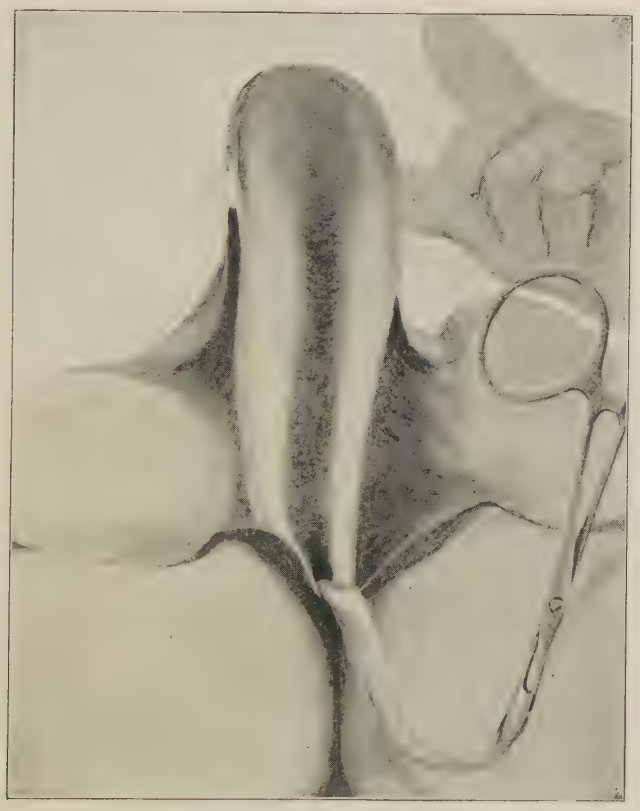

Fig. 13.—Corpus spongiosum containing urethra dissected away from corpora cavernosa, cut through and hanging down at lower angle of the wound.

made along the raphé of the scrotum, splitting it into two halves. The dissection is carried down so that the corpus spongiosum is seen perforating the triangular ligament, with the corpora cavernosa lying on either side and attached to the rami of the pubes. (Fig. 12.)

The corpus spongiosum, containing the urethra, is then dissected away from the corpora cavernosa for three inches, cut through, and

allowed to hang down out of the way, at the lower angle of the wound. (Fig. 13.)

The next step is to separate the corpora cavernosa from their attachments to the rami of the pubes. It is generally recommended that this should be done with a periosteal elevator. The close attachment to the

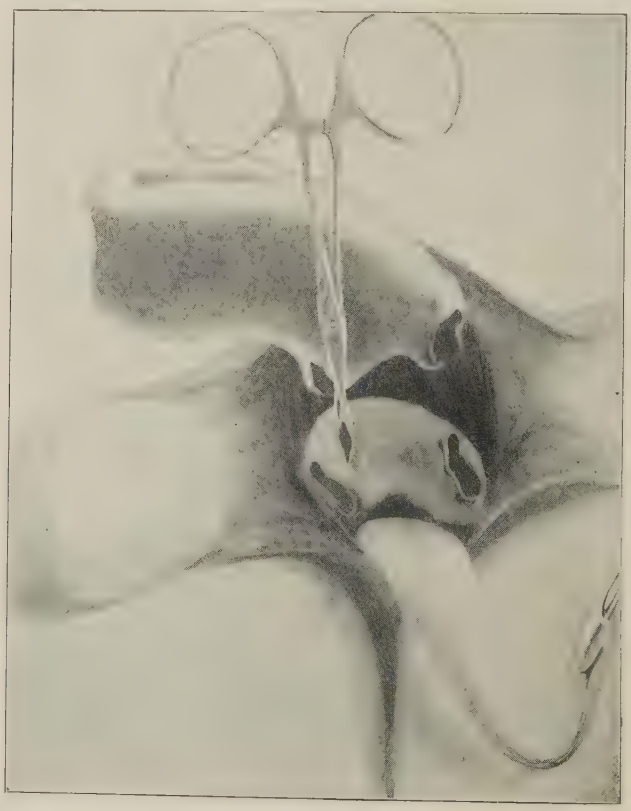

Fig. 14.—Charred stumps of corpora cavernosa after separation from pubes by burning through them with Paquelin cautery.

bones renders this a matter of considerable difficulty, and after separation there is a free hemorrhage, which is difficult to control.

The author prefers to burn through the crura penis, with a Paquelin cautery, close to their attachments to the bone, and in this way the corpora cavernosa are readily freed from the pubes and without hemorrhage. (Fig. 14.) The Paquelin can also be used to stop bleeding, which generally occurs from the dorsal vessels of the penis under the symphysis pubis, at the upper angle of the wound.

The final steps of the operation consist in bringing the urethra up into the wound and stitching it to the margins of the skin-flaps, and then the skin on either side is brought into apposition and stitched, and a gauze drain is introduced along the under side of the urethra to the bottom of the wound. (Fig. 15.)

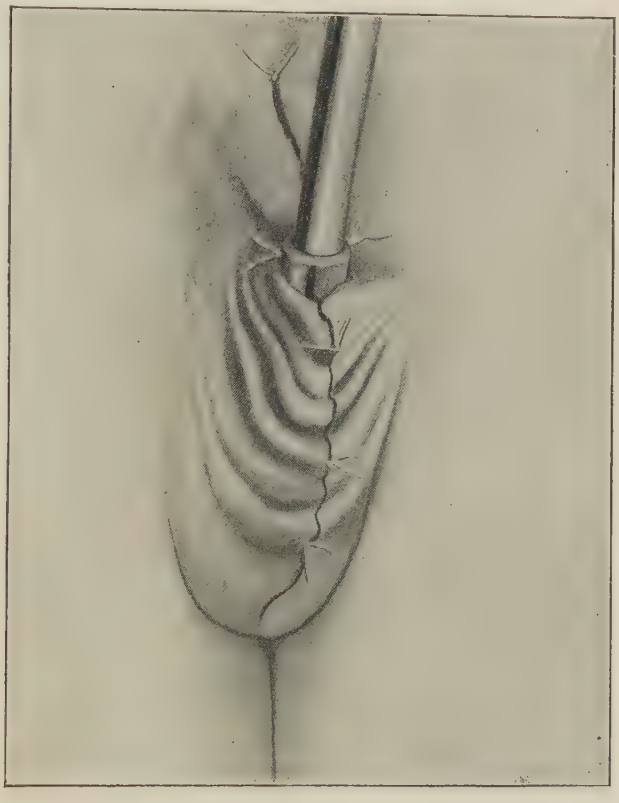

Fig. 15.—Operation as completed. Urethra sutured into wound, with sound introduced through it.

A catheter may be carried through the urethra and left in the bladder to drain it.

In this operation the testicles are exposed and may be left in the wound, or castration may be performed, to quell the sexual desire on the part of the patient after his recovery.

The inguinal lymphatic glands should be removed at the time any operation is performed for the relief of malignant disease of the penis, for if the glands have become infected, which occurs early in the disease, a recurrence of the cancer will inevitably take place later on.

DISEASES OF THE URETHRA AND ITS ADNEXA.

CHAPTER II.

ANATOMY OF THE URETHRA.

THE urethra is an S-shaped canal, whose walls lie in wrinkled folds and come closely in contact, except when distended by the passage of urine or a catheter.

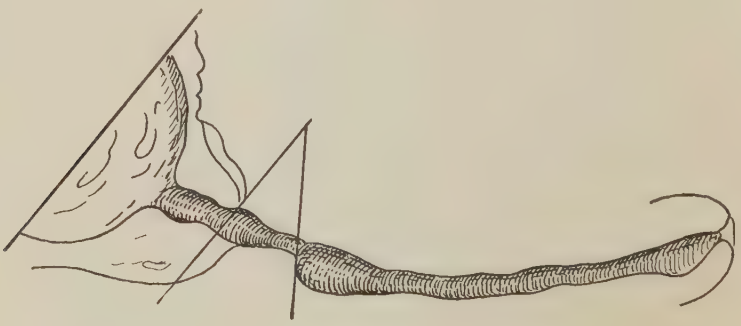

Fig. 16.—Wax cast of the normal urethra, showing its points of narrowing and dilatation.

The length of the canal from meatus urinarius to sphincter vesicæ is about eight inches and it is divided into three regions:—

(*a*) The anterior or pendulous urethra, which is six inches in length.

(*b*) The membranous urethra, which is about one inch long.

(*c*) The prostatic, or posterior, urethra, which is one inch in length.

The anterior urethra is surrounded by the erectile tissue of the corpus spongiosum, which terminates in the bulb. At a point corresponding to the bulb, in the anterior urethra, and lying between the penoscrotal junction and the anterior layer of the subpubic triangular ligament, for a distance of an inch, is a part of the canal which is termed the *bulbous urethra*.

The membranous urethra is the portion of the canal lying between the anterior and posterior layers of the triangular ligament. Its mucous membrane is not so richly supplied with mucous glands and follicles as

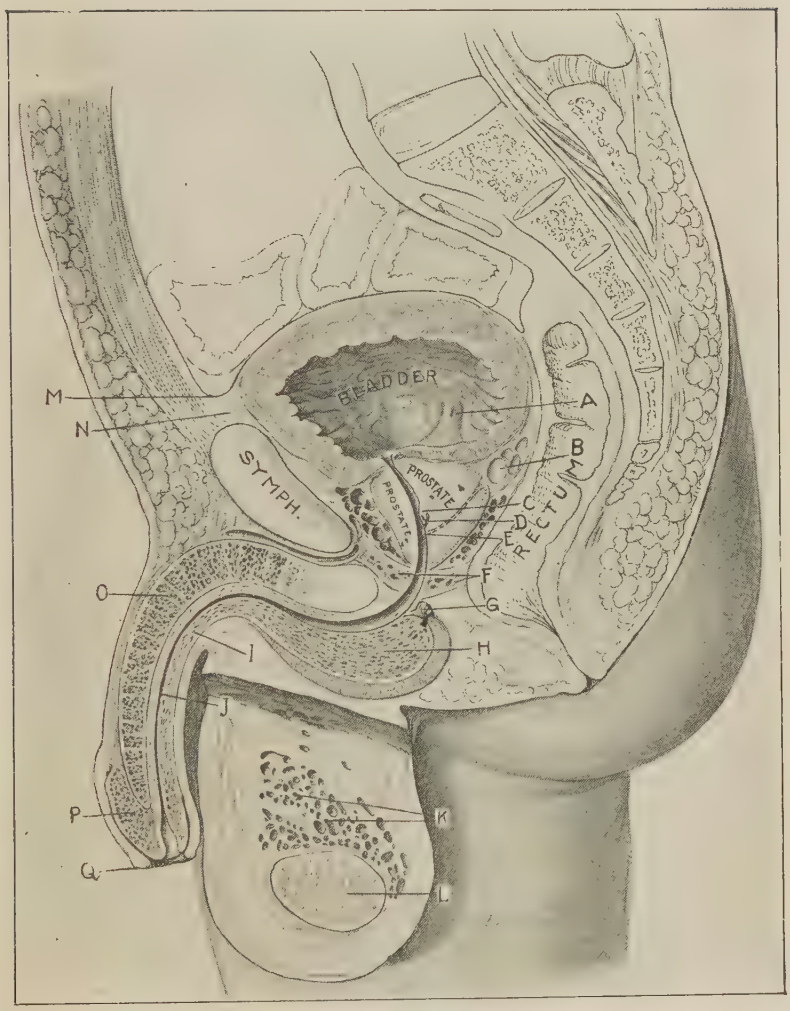

Fig. 17.—Section through bladder, urethra, and testicle. *A*, urethral orifice; *B*, seminal vesicle; *C*, colliculus seminalis or verumontanum; *D*, prostatic utricle; *E*, orifice of ejaculatory duct; *F*, suspensory ligament; *G*, Cowper's gland; *H*, bulb of corpus spongiosum; *I*, corpus spongiosum; *J*, urethra; *K*, seminal plexus; *L*, testicle; *M*, peritoneal fold; *N*, space of Retzius; *O*, corpus avernosum; *P*, glans penis; *Q*, prepuce.

the other portions of the urethra, and it acts as a barrier to the onward progress of a gonorrheal inflammation.

The membranous urethra is surrounded by bands of voluntary muscular fibers known as the **cut-off muscle,** or *compressor urethræ,* which is normally in a state of tonic contraction, and acts as a valve to separate the anterior from the posterior urethra.

Before the act of urination the cut-off muscle is relaxed in order

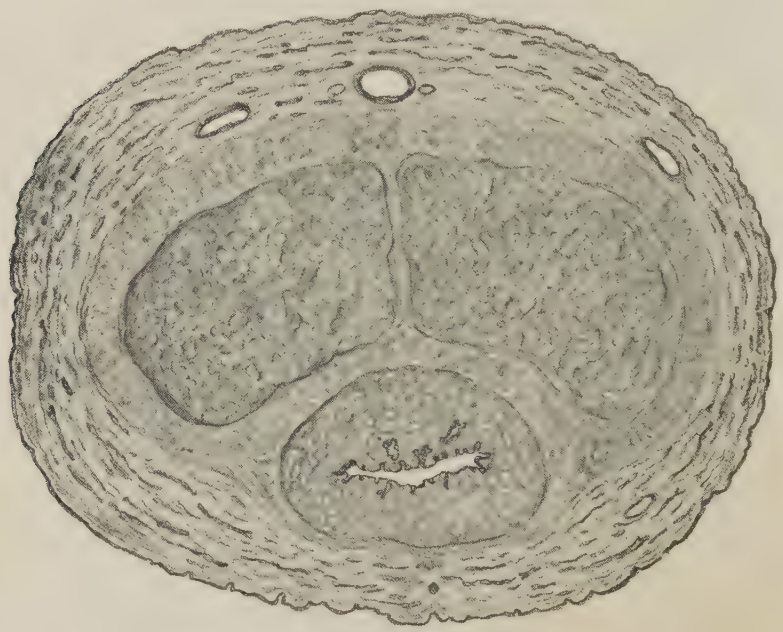

Fig. 18.—Section through corpora cavernosa and corpus spongiosum, showing urethra and Littré's glands.

to allow the urine to flow out past it, and by its voluntary contraction the flow of urine can be instantly shut off.

The cut-off muscle is sometimes affected by a cramp-like contraction and fails to relax, causing retention of urine or rendering it difficult or impossible to pass a sound. This condition is known as spasmodic stricture.

The prostatic, or **posterior, urethra** perforates the prostate gland. It is very richly supplied with mucous glands and follicles. Upon its floor is a small elevation composed of erectile tissue and abundantly supplied with nerves, and called the **colliculus seminalis** or **verumontanum.**

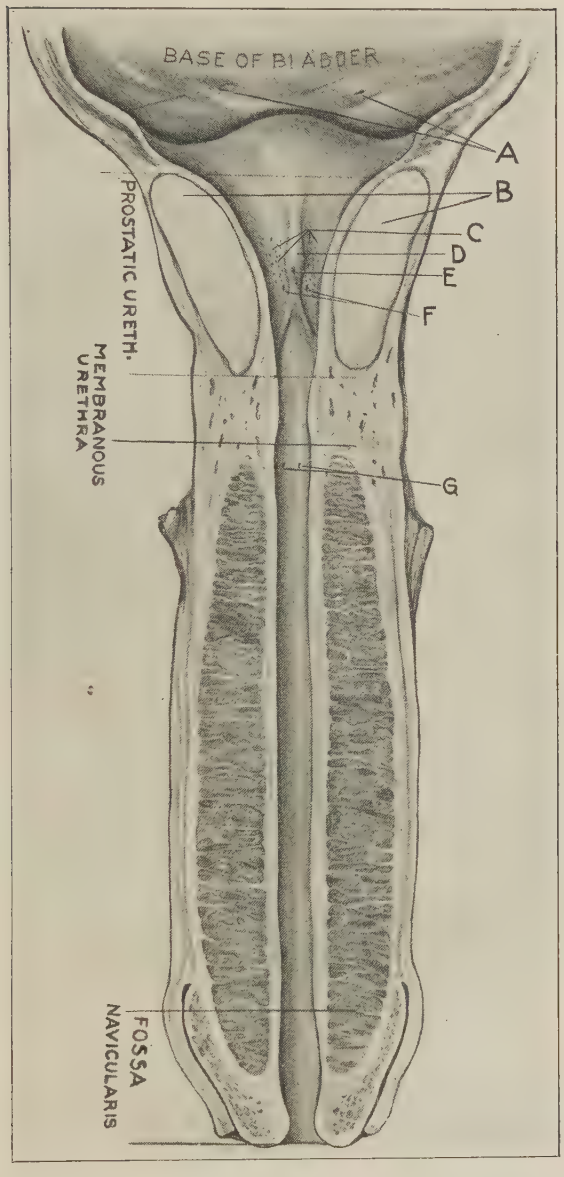

Fig. 19.—Bladder and urethra laid open to show the floor. *A*, ureteral orifices; *B*, prostate; *C*, prostatic ducts; *D*, colliculus seminalis or verumontanum; *E*, prostatic utricle; *F*, ejaculatory ducts; *G*, ducts of Cowper's gland.

At its top is a slit-like orifice, which leads into a *cul-de-sac* within its substance—the **prostatic utriculus.**

At the sides of the colliculus are two **lateral grooves** or **sulci,** in which are situated on either side the small, round openings of the ejaculatory ducts.

The **prostatic ducts** are usually twelve in number, but may be

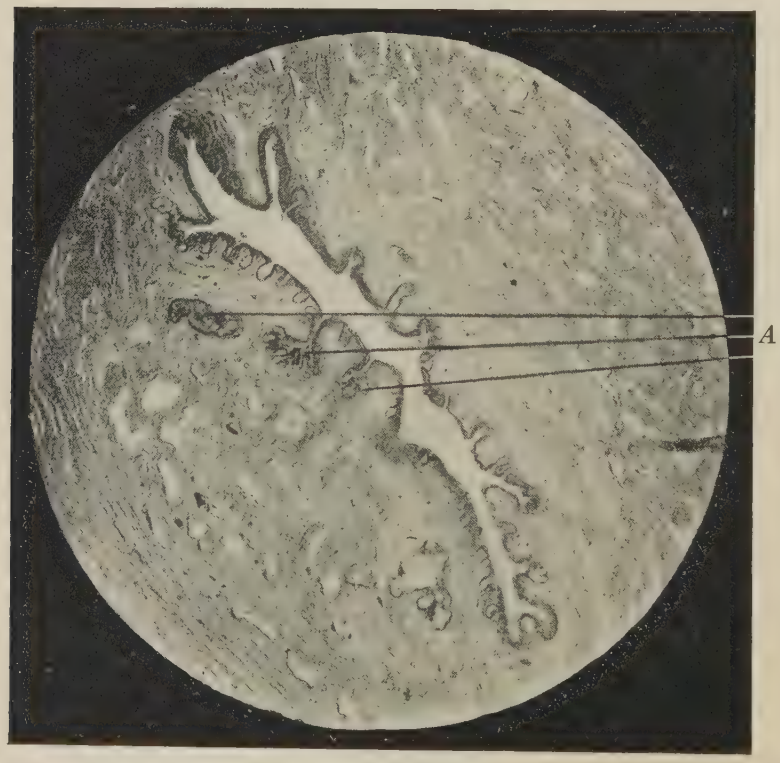

Fig. 20.—Cross-section of urethra, showing Littré's glands.
A, glands of Littré.

twenty or thirty, and open alongside the orifices of the ejaculatory ducts, upon the lateral slopes of the colliculus and in the lateral sulci.

The urethra is not like a tube of uniform caliber, but is a canal of varying width and distensibility. There are three points of **physiological narrowing:—**

I. At the meatus.

II. Somewhere in the third inch.

III. The membranous urethra, lying between the anterior and posterior layers of the triangular ligament.

The **points of widening** which are susceptible of instrumental dilatation to a considerable extent are as follows:—

I. The fossa navicularis, which is located just within the meatus, and contains in its roof a large mucous crypt: the lacuna magna. Guerin's fold is located at its posterior margin.

II. The bulbous urethra, which lies just in front of the triangular ligament and extends for one and one-half inches. It is the widest and most dilatable part of the anterior urethra, and contains the orifices of the ducts from Cowper's glands.

III. The prostatic urethra, usually termed the posterior urethra, is capable of greater distention than any other portion of the urethral canal, and may be dilated to 40 or 45 of the French scale without injury.

The mucous membrane which lines the anterior and membranous urethra is soft, delicate, and easily lacerated, and is composed throughout its entire length, excepting the fossa navicularis, of epithelial cells of the *cylindrical* variety.

The epithelium lining the prostate urethra is of the transitional variety, the deepest layer being formed of cylindrical cells, while above these is a layer of polygonal or irregular-shaped cells, and the most superficial layer is composed of several strata of large, flattened cells. This same variety of epithelium is formed in the pelvis of the kidney, ureter, and bladder.

The mucous membrane throughout the urethra is richly supplied with glands and follicles.

The glands of Littré lie beneath the mucous membrane in the meshes of the corpus spongiosum and are true glands, lined with secreting epithelium and provided with a duct which empties upon the free surface of the urethral mucous membrane. They are very numerous, and are arranged in groups together.

The follicles of Morgagni are simple crypts or depressions of the urethral mucous membrane, and are located upon the roof of the canal.

CHAPTER III.

ACUTE URETHRITIS.

Acute urethritis may be divided into **three varieties:—**

(*a*) **An aseptic catarrh,** in which no micro-organisms are present and which is due entirely to chemical irritation.

(*b*) **Non-gonorrheal** or **simple urethritis,** which is occasioned by inoculation of the urethral mucous membrane with pyogenic bacteria (staphylococci, streptococci, bacterium coli, or pseudogonococci).

(*c*) **Specific** or **gonorrheal urethritis,** which is produced by the gonococcus of Neisser.

Among the **predisposing causes** to any variety of urethral inflammation may be mentioned a damaged condition of the urethra from previous disease which has left behind granulations, erosions, or a stricture; anatomical abnormalities, such as a long and narrow prepuce, a wide urethral orifice, and hypospadias; certain diathetic states, such as gout, rheumatism, and tuberculosis, which predispose to inflammation by lowering the resisting power of the body to bacterial invasion.

An aseptic catarrh of the urethral mucous membrane may be artificially caused by injecting the canal with a solution of nitrate of silver. The irritation and discharge last from twelve to forty-eight hours, and subside spontaneously.

Another variety of the aseptic catarrh occurs in persons of a gouty diathesis, and may be designated as a *uric acid urethritis.*

It is a purely irritative inflammation, and is caused by the sharp points of the crystals when present in the urine in quantity. Under the administration of citrate of potash and large draughts of water to neutralize the urine, it promptly disappears.

NON-GONORRHEAL OR SIMPLE URETHRITIS.

Any of the pus-producing bacteria—*i.e.,* staphylococcus, streptococcus, etc.—will excite a catarrhal inflammation, with suppuration, of the mucous membrane, if introduced into the urethra. The micro-organisms may be introduced from without, through sexual intercourse, and are contained in menstrual discharges, leucorrhea, secretions from an ulcerated cervix, and uterovaginal discharges of any character. They may also be introduced upon a dirty sound or catheter. On the other hand, the bacteria may lie dormant and unsuspected in the patient's own urethra,

concealed in the crypts and follicles or the folds of mucous membrane, and may be lighted into activity through overindulgence in alcohol, intense erotic excitement, excessive coitus, or traumatism produced by the passage of a sound.

After an attack of gonorrhea, a damaged condition of the urethra is often left, which affords a favorable ground for the growth of bacteria other than the gonococcus.

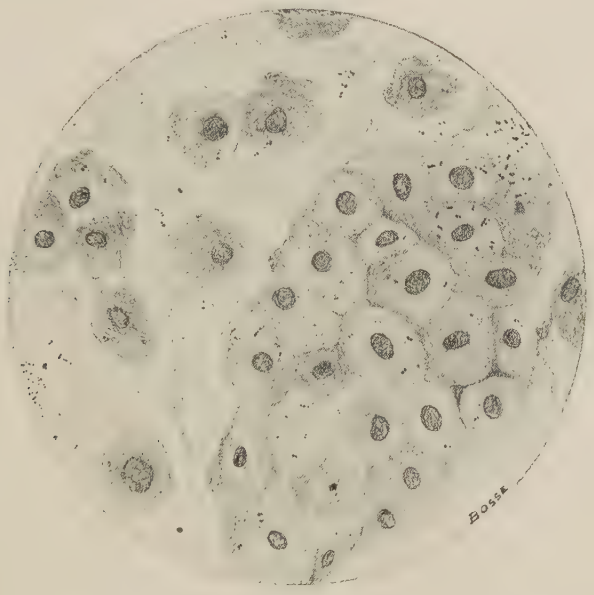

Fig. 21.—Simple or non-gonococcic urethritis. Epithelial cells and diplococci. Original drawing from microscopic specimen.

As a result of uncleanliness and balanitis, the organisms enter the urethra through the meatus; or in cases of obstinate constipation they make their way into the blood-circulation from the rectum, are discharged with the urine, and are deposited in the diseased spots in the urethra. Here they find a favorable culture-medium in the pus which is present, and can lead to the same complications of prostatitis and epididymitis which occur in a true gonorrhea.

In general, however, the inflammatory process in a simple urethritis is less severe than in the gonorrheal form, and it is limited to the mucous membrane, without involving the submucous tissues.

I. PSEUDOGONOCOCCIC URETHRITIS

begins insidiously after a longer period of incubation than true gonorrhea. There is but little discharge, slight tendency to involve the posterior

urethra, and no sequelæ. A cardinal feature is the marked tendency to recurrence. The organism is probably identical with Heimann's pseudogonococcus and Pfeiffer's micrococcus catarrhalis. It occurs in pairs, of which the members are unequal in size. It is generally extracellular and decolorizes by Gram's method.

The resemblance to the true gonococcus makes the diagnosis difficult. The only way in which a positive diagnosis can be made is by growing the organism. It will grow on ordinary media, in the form of white opaque colonies, as well as on blood-serum agar. The fact that the true gonococcus refuses to grow on ordinary media serves to distinguish the two organisms.[1]

In actual practice, a urethritis characterized by the presence of diplococci which decolorize by Gram's method is almost invariably due to infection with the true gonococcus of Neisser. Nevertheless, the possibility of the existence of the pseudogonococcus should be borne in mind, as otherwise the faith of a husband in the chastity of his wife or of a lover in the exclusiveness of his mistress may be unjustly destroyed.

II. STAPHYLOCOCCIC AND STREPTOCOCCIC URETHRITIS.

The inflammation caused by the introduction of these organisms into the urethra has often a longer incubation period, but runs a shorter and less severe course, than a true gonorrhea, and is not liable to have any complications.

While this statement is true of the vast majority of cases, Waelsch[2] and Galewsky[3] describe a urethritis characterized by a long incubation period, very slight subjective and objective symptoms, and an exceedingly chronic course, lasting in some cases four or five years.

In some of the reported cases, no organisms whatsoever were found; in others, streptococci, a milk-white diplococcus, and a slender bacillus were present, but the gonococcus was absent in every instance.

TREATMENT.

The treatment of simple urethritis consists in hygienic measures, rendering the urine bland, and the use of a mild astringent injection which answers very well for the light cases. If irrigations are used, the nitrate of silver (1:4000) frequently causes a prompt subsidence of the discharge, because the micro-organisms do not penetrate deeply into the tissues, but grow on the surface of the mucous membrane. Here

[1] J. C. Johnston, Journal of Cutaneous and Genito-Urinary Diseases, September, 1902.

[2] Prager med. Wochenschrift, 1911, No. 43.

[3] Centralblatt f. Harn. and Sexual Organs, 1903, No. 14.

the irrigation of nitrate of silver comes in direct contact with them and destroys them, and at the same time causes a desquamation of the superficial cells upon which the germs have proliferated. One or two irrigations may succeed in ridding the tissues of micro-organisms and infiltrated epithelial cells.

This statement does not apply to the cases described by Waelsch, which are exceedingly obstinate and do not appear to respond to any form of local treatment. Galewsky believes that better results are obtained from the use of the balsams internally than from irrigations, used alone or combined with dilatations.

In the last few years the introduction of *oxycyanide of mercury* into urological practice has given us an efficient antiseptic for irrigating the urethra.

It is regarded as the sovereign remedy for all septic conditions except those caused by the gonococcus, and destroys most organisms when used in the strength of 1 : 4000, which does not irritate the urethra or bladder.

By using it before passing a sound or catheter, it is possible to sterilize the urethra to a large extent, and in cases of simple urethritis its use is to be preferred to nitrate of silver on account of its unirritating qualities. Bichloride of mercury, 1 : 20,000, is also very useful in destroying the staphylococcus in the urethra.

GONORRHEA.

Gonorrheal inflammation of the urethra is caused by the **gonococcus of Neisser.** The period of incubation is usually from four to seven days, but in rare instances may extend to fourteen days.

PATHOLOGY.

The gonococci are introduced into the urethra, usually in utero-vaginal secretions or upon an infected instrument. They do not remain upon the free surface of the urethral mucous membrane, but rapidly penetrate between the epithelial cells, and are to be found in the submucous connective tissue itself. They increase and multiply in colonies, in the interepithelial spaces and upper layers of the submucous connective tissue, and the toxic substances which they produce cause reaction on the part of the tissues, which is characterized by dilatation of the blood-vessels and discharge of serum and leucocytes. The cylindrical epithelium cells lining the urethra are loosened by the flow of secretion and are desquamated, forming **erosions** of the epithelial surface.

An active process of **phagocytosis** takes place, by which the gonococci are taken into the pus-cells and thus removed from the tissues,

and, in cases which run a normal course, the gonococci have almost entirely disappeared from the submucous connective tissue and deeper layers of the mucous membrane by the end of the second or third week.

When the *stage of decline* commences, the epithelial erosions begin to undergo repair, by being covered with squamous epithelium in many layers. The gonococci which have been removed from the deeper tissues now begin to grow luxuriantly on the free surface of the mucous membrane after the manner of a sod of grass, and a desquamation of the upper layer of the newly formed epithelial cells takes place, carrying with them their attached colonies of gonococci.

In normal and ordinary cases the process of getting rid of the gonococci is accomplished in the *ascending stage* by *phagocytosis,* and

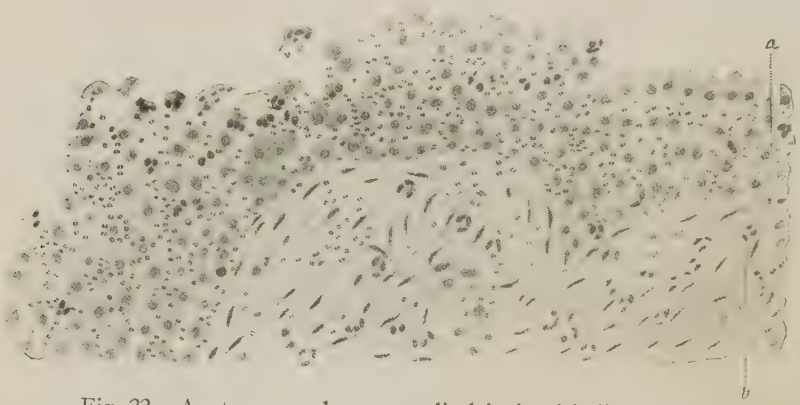

Fig. 22.—Acute gonorrhea. *a,* cylindrical epithelium, infiltrated with pus-cells and gonococci; *b,* submucous connective tissue, with pus-cells and gonococci. (From "Die Syphilis und die Venerischen Krankheiten," von *Dr. Ernest Finger.*)

in the *stage of decline* through *desquamation* of the *epithelial cells;* so that in the fifth or sixth week, in favorable cases, the gonococci have disappeared entirely from the urethra, and the inflammation ceases.

Morgagni's crypts and Littré's glands are also affected by the inflammatory process, which occurs *within* their cavities as well as around them, and the cavities of the glands act as foci of suppuration and incubating places for gonococci for months after the inflammation has ceased on the free surface of the mucous membrane. An **infiltration of small round cells** which are derived from a proliferation of the fixed connective-tissue cells, and from leucocytes which have escaped from the capillaries, occurs as part of the process of inflammation, and may be (*a*) **superficial,** or confined to the mucous membrane and its connective-tissue layer immediately underneath, and

dipping down and surrounding Morgagni's crypts and Littré's glands, or may be the (*b*) **deep form,** in which, in addition to affecting the mucous membrane and glands, the small round-celled infiltration involves the *deeper* submucous tissues, extending into the spongy tissue of the corpus spongiosum, in severe cases. The crypts and follicles are usually surrounded by and imbedded in the small round-celled infiltration.

Healing of the lesions is brought about by a removal from the tissues of the gonococci, through (*a*) phagocytosis and (*b*) desquamation of the epithelial cells, which have been invaded by the gonococci. When the gonococci have been entirely removed, suppuration ceases.

The *erosions* either (*a*) become covered with squamous epithelium in many layers, which offers a barrier to the renewed invasion of the

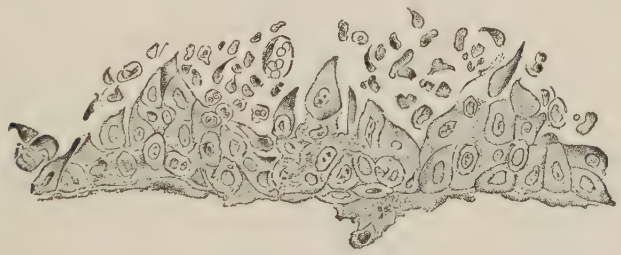

Fig. 23.—Gonorrheal conjunctivitis. Invasion of epithelial layer by gonococci, and desquamation of the superficial layers of cells.

tissues by gonococci, or (*b*) the erosions remain without being covered by squamous epithelium, but become the seat of *granulations,* and occasion a gleety discharge.

The *small round-celled infiltration* (*a*) disappears by absorption, especially when superficial and confined to the mucous membrane, and the urethra becomes healthy, soft, and flexible, or (*b*) the small round-celled infiltration is *not* absorbed, especially when deep-seated,—*i.e.,* involving submucous tissue and cavernous tissue of the corpus spongiosum,—but becomes *transformed* into *true fibrous connective tissue,* called *stricture.*

Relapses are frequent, and are due to reinfection of the submucous tissues from a focus of suppuration located either in (*a*) Morgagni's crypts or Littré's glands, (*b*) the seminal vesicles, or (*c*) Cowper's glands or the prostatic crypts.

The manner in which a relapse takes place is as follows: If premature coitus or an excess of beer is indulged in, hyperemia of the mucous membrane, with increased secretion, follows and the protecting layer of squamous epithelium is torn asunder. The gonococci penetrate through

these clefts into the deeper tissues and again cause their irritative symptoms.

If the gonococci remain in the urethra for a considerable length of time a state of tolerance of the tissues is established and with each successive relapse the inflammatory reaction becomes less and less until, with the third or fourth relapse, the energy of reaction is not enough to bring the gonococci out of the submucous tissues. As a consequence, the gonococci remain and give rise to a permanent irritation of the submucous connective tissue, an infiltration of small round cells occurs, and the gonorrhea becomes *chronic*.

COURSE.

The inflammation begins at the meatus, and in *favorable* cases affects the *anterior* urethra only, stopping at the cut-off muscle.

Stages.—*Prodromal.*—The symptoms are a slight tickling at the meatus, and a light-bluish, sticky discharge, with some slight stinging on urination. These last a couple of days, and then begins the *increasing stage:* The amount of pus increases. It is creamy yellow in color or greenish yellow from admixture with blood. Hemorrhages may occur. The pain on urination is intense, and is occasioned by the sudden distention of the infiltrated walls of the urethra by the outflow of urine. Neuralgic pains in the back, perineum, groin, and spermatic cord are present. Constitutional disturbance in the shape of fever and a feeling of prostration often occurs. The prepuce may become edematous and cause phimosis or paraphimosis.

Chordee is of frequent occurrence. It consists in an erection of the penis, with a painful incurvation downward. It is caused by an infiltration into the spongy tissue of the corpus spongiosum which surrounds the urethra and renders it rigid and inextensible. On account of the rigidity of the urethra the stream becomes small and twisted, and dribbling after urination occurs.

This condition continues without change for the better for about three weeks, and during this time it is known that the gonococci have been proliferating in the submucous tissues. At the moment when the gonococci have been removed from the deep tissues and begin to grow upon the free surface of the mucous membrane, the acute symptoms subside, and usually in the course of the third week the *stage of decline* begins. The pain on urination and the chordee lessen, the discharge becomes more watery and less in quantity, until it finally diminishes to a drop in the morning, which ultimately disappears.

Endoscopic examination, or the introduction of any instrument,

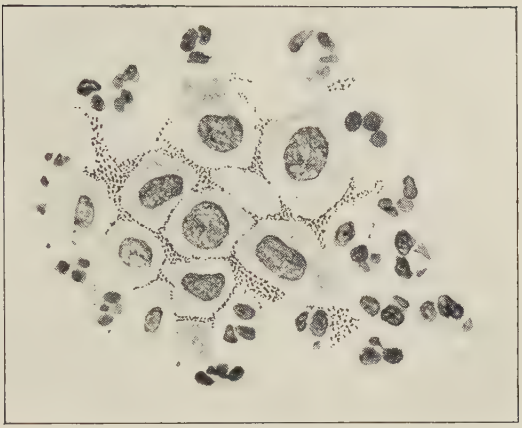

Fig. 24.—Acute gonorrhea. Prodromal stage. Clump of desquamated cylindrical epithelium, with colonies of gonococci growing between them. Original drawing from microscopic specimen.

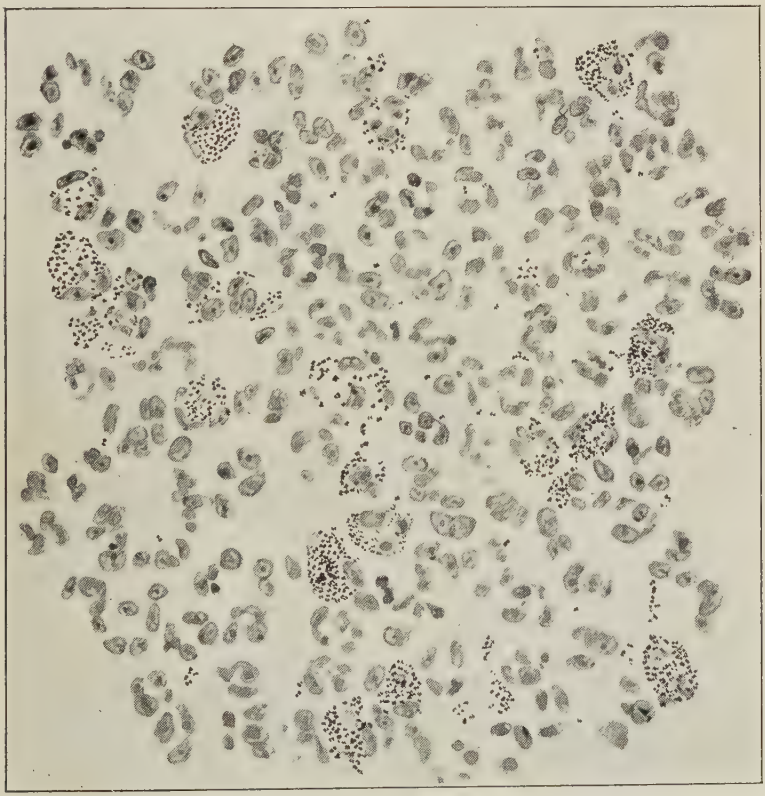

Fig. 25.—Acute gonorrhea. Ascending stage. Pus-cells filled with gonococci. Original drawing from microscopic specimen.

should be strictly avoided in the acute stage. But if an endoscope were used, the appearance would be as follows:—

The mucous membrane appears swollen, edematous, intensely red, and covered with pus. The glands and follicles are very markedly affected. The mucous membrane around their openings is more swollen and the openings themselves gape. Erosions, from desquamation of the

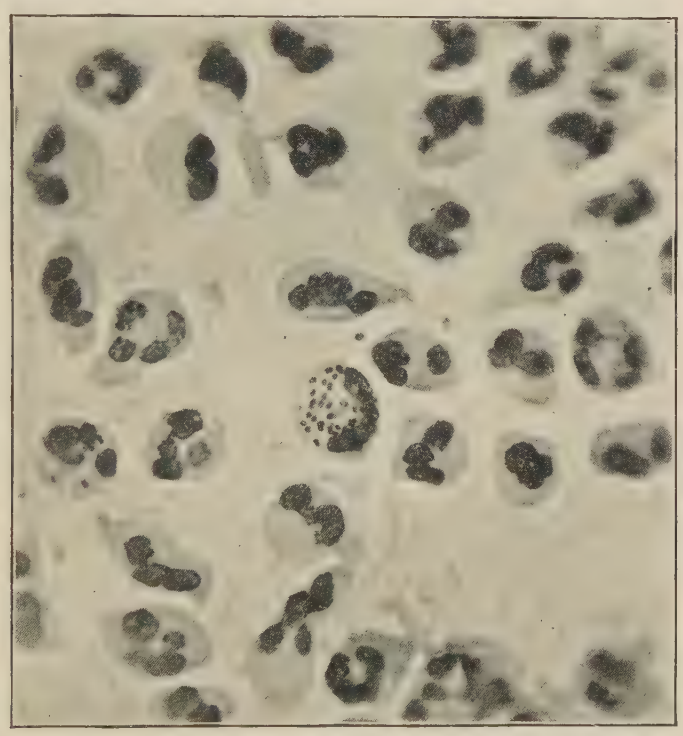

Fig. 26.—Pus-cells containing group of gonococci. Courtesy of Hoagland Laboratory.

cylindrical epithelium, appear in the vicinity of the glands. Granulations may form upon the erosions, later in the course of the disease. The submucous tissue is infiltrated, rendering the canal swollen and rigid.

Examination of Urine.—The two-glass urine test should be made at each visit to determine:—

(*a*) If the *posterior* urethra has been affected.

(*b*) The amount of pus secreted.

The urine passed into a glass appears turbid from admixture with pus, and little clumps or masses of desquamated epithelium are present. After standing, the pus settles to the bottom of the glass, and a cloud of

mucus appears floating above it. As the case goes on toward recovery the pus disappears, but the hypersecretion of mucus continues, and occasions a cloudy appearance in the urine, resembling mucilage added to it.

After the mucus disappears *clap-shreds* persist for months, showing that *isolated portions* of mucous membrane are *not covered* with *epithelium,* and are *still secreting pus.*

MICROSCOPIC EXAMINATION OF PUS.

In the prodromal stage, when the discharge from the meatus is thin and scanty, microscopic examination of smears shows quantities of desquamated, cylindrical, epithelial cells and a moderate number of pus-cells containing clumps of intracellular gonococci.

In the ascending stage large numbers of pus-cells, many of them containing gonococci, and a number of free gonococci are to be seen, on account of the cells having ruptured, allowing them to escape.

The stage of decline is denoted by the appearance of squamous epithelial cells, showing that the erosions have begun to cicatrize and become covered with newly formed epithelium.

Clumps of gonococci are also present, adhering to the epithelium.

The pus-cells have diminished in numbers and fewer of them contain gonococci. As the disease continues to improve, pus-cells and gonococci disappear, and finally the discharge from the meatus is found to be composed only of squamous epithelium, mucus, an occasional pus-cell, and no gonococci.

It is of the *utmost importance* to make sure of the entire disappearance of all gonococci before permitting coitus, on account of the danger of infection in case the gonococci are not removed.

If no purulent discharge is obtainable from the meatus it is proper to excite a simple urethritis, by injecting the urethra with nitrate-of-silver solution, gr. x to the ounce.

If gonococci are lurking in the crypts or a granular patch, the suppuration caused by the injection will bring them to the surface, and they can be found by microscopic examination of the discharge.

The writer considers that the use of the microscope is indispensable in the management of cases of gonorrhea, not merely for establishing the diagnosis, but also as a control for observing the progress and stage of the disease, for selecting the appropriate treatment for the different periods, and finally to determine if the gonococci have all been eliminated and the patient is cured.

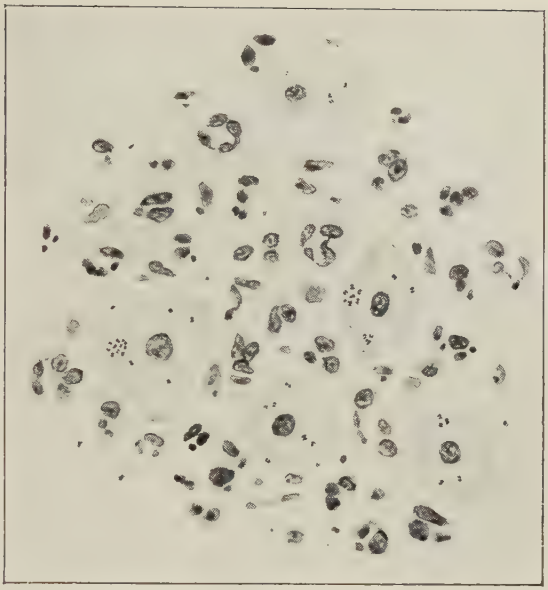

Fig. 27.—Acute gonorrhea. Stage of decline. Desquamated squamous epithelium, with colonies of gonococci growing on them and pus-cells. Original drawing from microscopic specimen.

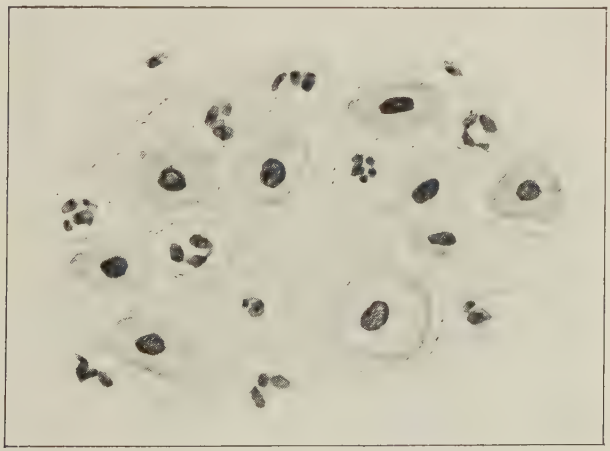

Fig. 28.—Gonorrheal shred. Squamous epithelium and a few pus-cells, held together by mucus. Gonococci have disappeared. Original drawing from microscopic specimen.

MORPHOLOGY OF THE GONOCOCCUS.

The gonococcus resembles in appearance two coffee-beans placed side to side, and, as it is removed by phagocytosis from the tissues, will of necessity be found lying *within* the pus-cells. A few gonococci may be found outside the pus-cells, if these have been ruptured. In the descending stage of gonorrhea the gonococci are found adherent to and growing upon the desquamated squamous epithelial cells.

Other micro-organisms—for example, the pseudogonococcus—which are not pathogenic, resemble the gonococcus in shape, but it is believed today that the gonococci can, in the great majority of cases, be recognized by decolorizing them by Gram's solution.

The microscopic examination for the gonococcus is pursued as follows in the Hoagland Laboratory, after the method of A. Hymans Van den Bergh:—

In the microscopic examination for the gonococcus it is well to have two smears of the pus on cover-glasses. One of these is stained with methylene blue, and if organisms are found which resemble the gonococcus the second smear is stained by Gram's method to confirm the diagnosis.

Preliminary Staining.—1. Make a thin smear on a cover-glass, of the pus supposed to contain the organisms.

2. Dry in the air and fix by passing three times through the flame, rapidly.

3. Stain for one minute in Löffler's solution of methylene blue (prepared by Eimer and Amend, or E. Leitz).

4. Wash in water, dry, mount in balsam, and examine with a one-twelfth oil-immersion.

The gonococci are found on examination to be stained blue.

In order to differentiate the gonococci from other organisms present which may resemble them, the second smear is stained by Gram's method, as follows:—

1. Stain in aniline-water gentian violet for five minutes.

2. Pour off excess of stain and cover with Gram's solution for one minute.

3. Decolorize with absolute alcohol until the smear is of a light-grayish color.

4. As a contrast stain for those bacteria which are decolorized by Gram's method carbol fuchsin diluted with 10 volumes of water or a saturated watery solution of Bismarck brown may be used.

5. Wash in water, dry, and mount in balsam.

FORMULÆ.

Nicolle's Modification of Gram's Method.—Carbol-gentian violet is used in place of aniline-water gentian violet. Treatment with Gram's solution is carried out as above and decolorization is effected with a mixture of acetone (1 part) and alcohol (2 parts).

Aniline-water Gentian Violet.—To 10 c.c. of distilled water in a test-tube add 1 c.c. of aniline oil. Shake thoroughly and filter through a wet filter until the filtrate is clear. To 9 parts of this aniline water add 1 part of a saturated alcoholic solution of gentian violet. This mixture will keep three to five days in a stoppered bottle.

Carbol-gentian Violet.—1 part of a saturated alcoholic solution of gentian violet is mixed with 10 parts of a 5 per cent. solution of carbolic acid.

Gram's Solution.—Iodine crystals, 1; potassium iodide, 2; water, 800.

Other micro-organisms, the pseudogonococcus, for example, resemble the gonococcus of Neisser in form, and the differential diagnosis is made by using *Gram's method of staining.*

If the organism decolorized, it was formerly considered an absolute proof that it was the gonococcus of Neisser. If, however, it did not decolorize, it was thought that we had to deal with the pseudogonococcus.

The absolute reliability of the Gram test has been somewhat shaken by later observations, for it is now known that a few other organisms will also decolorize by Gram.

Steinschneider and Galewsky have found, however, that the Gram test can be depended upon in 95½ per cent. of the cases.

It is believed today that the only way to determine the character of a suspected organism is to make a culture.

The growth of the organism on blood-serum agar or similar culture media, and its failure to grow on ordinary agar, glycerin agar, and gelatin, proves absolutely the organism is the true gonococcus of Neisser.

DURATION OF AN ATTACK OF GONORRHEA.

When the posterior urethra is not affected a favorable case of gonorrhea recovers in from five to six weeks. In very exceptional instances recovery may occur in three to four weeks, but in these cases there is always a doubt as to the correctness of the diagnosis of true specific gonorrhea, although under the modern treatment with silver albuminate salts the duration is materially shortened.

The first attack is the most severe, but most liable to recover without stricture. Later attacks are apt to follow the course of the first one, in having a repetition of the complications.

The virulence of the cultures of the gonococcus seems to differ materially.

It is often noted that when an individual has had chronic gonorrhea for months or years the gonococci when transplanted into the tissues of another person are not capable of producing such virulent inflammatory symptoms, as if taken from a fresh case.

This attenuated virulence would seem to explain the fact that in such cases the period of incubation is comparatively long, the purulent discharge is scanty, and the cases often become chronic, resulting in stricture and prostatitis. This course and termination are probably due to the fact that the irritation is too slight to cause enough phagocytosis to rid the tissues of the invading organisms.

Another condition which influences the prognosis in gonorrhea is the state of the patient's general health.

Gonorrhea acquired by an individual affected with phthisis or general debility is apt to run a subacute, but exceedingly protracted course.

The causes which retard recovery may be grouped as follows:—

(*a*) Complications, posterior urethritis, prostatitis, etc.
(*b*) Reinfection from a urethral gland, seminal vesicle, prostate, etc.
(*c*) Lack of rest.
(*d*) Habits of drinking.
(*e*) Injections which are too strong or too frequently repeated.
(*f*) Constitutional causes: *i.e.*, gout, tuberculosis, etc.
(*g*) Premature coitus.

PROPHYLAXIS.

To avoid acquiring gonorrhea, coitus should not be too prolonged and should be limited to a single act, and the man should urinate immediately afterward to wash away any vaginal secretion which may have gained access to the urethra. This is by no means infallible, and in spite of such precautions infection very frequently occurs.

Finger advises the use of a condom, which is in no way injurious, and unless accidentally ruptured during coitus is a perfect safeguard against infection or impregnation.

Since the introduction of the albuminates of silver, a remedy has been placed in our hands which affords a reliable means of preventing gonorrheal infection.

Frank,[1] of Berlin, made experiments on six men into whose urethræ gonorrheal pus was artificially introduced.

Three of these received a prophylactic instillation of 3 to 5 drops

[1] Allg. Med. Central. Zeitung, 1899, No. 5.

of a 20 per cent. solution of protargol dissolved in glycerin. The others were not so treated.

The three patients who did not receive the prophylactic instillation developed gonorrhea and the other three escaped. The experiment was repeated with the same result.

Kopp, Zeissel, and others have made similar experiments and confirm Frank's observations.

Since the introduction of Albargin, Frank uses a 5 per cent. solution of this salt in glycerin, on account of its comparatively unirritating qualities, with the same results.

All the observers agree that the prophylactic instillation, if used immediately after coitus, will destroy any gonococci which may have entered the urethra, without causing any damage to the tissues.

Since the adoption of the prophylactic treatment in the U. S. Navy the reduction of the number of cases of venereal disease has been most striking. In a report published by Asst. Surg. W. S. Pugh, the method employed is as follows:—

After his return from shore leave the sailor reports to the hospital steward, and after cleansing the genitals with soap and hot water, and urination, 5 c.c. of a 2 per cent. solution of protargol with the addition of 15 per cent. of glycerin are injected into the urethra and held five minutes.

Metchnikoff's calomel ointment is then applied to the penis and left on for two hours, to prevent syphilis. (See chapter on Syphilis.)

In the time covered by the report were 3000 shore leaves, and 756 men who were exposed to venereal disease took prophylaxis and did not develop venereal disease.

If the public in general were aware that reasonably efficient prophylactics existed which if used immediately after coitus would almost surely prevent gonorrhea and syphilis and the use of these remedies were to become common, one of the great questions of the day, viz., what can be done to prevent the spread of venereal disease, would be in large part answered.

TREATMENT.

Gonorrhea is a *self-limited disease*, and the suppuration may be looked upon as an effort on the part of the tissues to remove the invading microorganisms; so that when the last gonococcus is removed suppuration ceases, unless postgonorrheal lesions in the urethra and infection with other bacteria cause a catarrhal inflammation with secretion, and a discharge of pus continues.

An expectant plan of treatment can only be carried out exceptionally, as in military hospitals, for instance. Here it is found that if a patient with gonorrhea is put to bed and fed on a bland diet, consisting chiefly of milk, in forty-five days, on an average, the gonococci are eliminated from the tissues and the suppuration has ceased. Under the existing social and business conditions, however, such a plan of treatment is practically impossible, and we have to adopt the methodic treatment.

As the gonorrheal inflammation begins at the meatus and does not reach the posterior urethra until the third week, or in favorable cases not at all, we will first consider the treatment of inflammation which is limited to the anterior urethra, and take up posterior urethritis in a subsequent section.

From the earliest times many efforts have been made to abort the course of a gonorrhea by using strong injections or pencilings of nitrate of silver and other caustics.

These attempts were all failures, and the increased irritation reacted most injuriously upon the course of the gonorrhea. Since the introduction of the albuminates of silver, **an Abortive treatment** has been suggested which is sometimes successful. The favorable cases are those which present themselves for treatment a few hours after the discharge is first observed and in which the *microscope shows leucocytes, much epithelium, and gonococci which are extracellular.*

Such cases can often be cured in six or eight days if treatment is begun at once. (Wossidlo and Frank.)

If the gonococci are very abundant and the case is three or four days old, the attempt may be made, but the outlook is not very good.

The method of applying the abortive treatment consists in irrigating the anterior urethra once a day with a 1 to 1,000 albargin solution, either with an irrigator with hydrostatic pressure (Janet method) or a large hand-syringe provided with a rubber tip.

The solution must be injected with the utmost gentleness and not forcibly, so as to avoid causing traumatism and prostatitis.

After the first injection the discharge is increased for a few hours, but in successful cases it becomes scant, slimy, and free from gonococci in from two to four days.

Gonosan is given internally, and the patient uses albargin as a hand injection once a day.

After five or six days, if the patient seems cured, a provocative injection with silver nitrate is made, to make sure that no gonococci are present.

Of 122 cases reported by Zenzes, 61 were cured within a few days.

If the pus continues, but the gonococci have disappeared, permanganate irrigations are useful in diminishing the discharge.

If after four or five days of this treatment, it is evident that the disease cannot be cut short, it must be treated as an ordinary case of gonorrhea.

ANTERIOR URETHRITIS.

Methodic Treatment.—There are certain **hygienic** directions which the patient should observe: he should keep quiet and spend as much time lying on a sofa or bed as possible.

It is very unfortunate that the business and social requirements of a patient with acute gonorrhea do not permit him to go to bed in every case, for the first week at least. If this were done in each instance posterior urethritis, prostatitis, and other complications would rarely occur, and in the end many patients would actually save time, by sacrificing a few days at the beginning of the attack. Every gonorrhea is a severe acute inflammation and demands rest in bed as much as an inflamed joint, and if treated with equal consideration would respond by certain and prompt subsidence. He should be warned of the danger of gonorrheal ophthalmia, and directed to wash his hands after handling the penis or dressings, to avoid carrying any pus into the eyes. He should also be directed to avoid all sources of sexual or erotic excitement.

The **diet** should be non-stimulating, and the patient should avoid meat in excess, highly seasoned or salty foods, sauces, condiments, strong tea or coffee, pickles, tomatoes, asparagus, and alcoholic drinks of all kinds, of which beer and champagne are especially detrimental.

Dressings for the purpose of catching the discharge and keeping it from the clothing are always necessary. The best form is made by cutting off the foot of a stocking and placing some absorbent cotton at the bottom; the penis is placed within it and the bag suspended from a waist-band, or the gonorrhea bag which is sold in the shops answers the same purpose.

Constricting the penis by wrappings should be carefully avoided, so as not to interfere with the return-circulation. If the discharge is but trifling, a pledget of cotton may be placed under a long foreskin to absorb it; but the cotton is not to be recommended if the discharge is profuse, as it will prevent the pus from flowing out freely from the meatus, and cause it to dam back.

A *suspensory bandage* should be worn in every case to relieve the sensation of *dragging* on the spermatic cord and perhaps lessen the danger of epididymitis.

Therapeutic Treatment.—The *balsams* of copaiba, cubebs, and sandal-wood oil have had for years a well-deserved reputation as anti-

blennorrhagics. They are eliminated by the kidneys, and affect the inflamed urethra as they pass over it, held in solution in the urine.

Sandal-wood is best adapted to the increasing stage, but acts well throughout the whole course of the disease. It may be combined advantageously with fl. ext. of kava-kava in 5-minim doses in capsule. This combination is known as *Gonosan*. The balsams of copaiba and cubebs have fallen largely into disuse, but are sometimes serviceable in the descending stage of a gonorrhea.

The dose of sandal-wood oil and the balsams is from 10 to 20 drops in capsules, three times a day.

Sandal-wood oil sometimes causes an intense pain in the back, or disagrees with the digestion, and has to be abandoned on these accounts, while copaiba often causes an erythematous eruption resembling measles.

While sandal-wood oil and the balsams are useful adjuvants in gonorrhea, it is necessary to have recourse to other measures to effect a cure.

Treatment of the Increasing Stage.—The bowels should be regulated by a saline cathartic given every second morning before breakfast, which depletes the pelvic blood-vessels and lessens congestion, and prevents the migration of the colon bacillus from the rectum to the urethra.

Alkalies or an alkaline mineral water should not be prescribed as a routine measure, for an alkaline reaction of the patient's urine is always caused by his abstinence from meat and his free use of milk, and the best prophylactic against the development of cystitis in gonorrhea is a strongly *acid reaction* of the urine, which inhibits the growth of any bacteria which may find their way into the bladder.

Diluents.—The patient should be directed to drink considerable quantities of pure distilled water—a glass every hour or two—with the object of *washing out* the urinary passages and keeping the urethra free from secretions which would otherwise form excellent culture-media for gonococci.

Sandal-wood oil is administered by the mouth, preferably in capsules. The well-known Lafayette mixture is commonly used in hospital and dispensary practice, but it has the disadvantages of containing an alkali and of having an abominable taste. Its formula is as follows:—

℞ Extracti hyoscyami fluidi ..... f℥ss.
Potassii citratis ..... ℥j.
Olei santali flavi ..... f℥ss.
Aquæ destillatæ ..... f℥ij.
Syrupi acaciæ ..... q. s. ad f℥vj.
Olei gaultheriæ ..... f℥ss.

M. Sig.: Two teaspoonfuls at a dose.

The *burning* on *urination* is lessened in some degree by the sandal-wood oil, but if very severe can be relieved by injecting 3ss of 4 per cent. cocaine solution into the urethra.

The local treatment by means of *astringent injections* is *entirely contraindicated during the ascending stage,* for, as we have already noted in considering the pathology, the gonococci at this time are in the upper layers of the *submucous connective tissue* and the *deeper cells* of the mucous membrane, and they are being removed from the deeper tissues as rapidly as possible by the phagocytic action of the leucocytes. Under these conditions the action of an astringent is to hinder the elimination of the gonococci from the depths, and so retard the natural healing process.

A pure antiseptic, however—such as some of the new silver salts—is entirely in order, and is effectual in moderating the severity and shortening the duration of the disease.

The indications for the cure of gonorrhea as formulated by Neisser are as follows:—

1. Destroy the gonococci in all foci within reach as early and completely as possible.

2. In doing so, avoid irritation of the mucous membrane, any exacerbation of the existing inflammation, and everything which has a caustic action on the tissues and all unnecessary pain.

The former plan of refraining from all local treatment in the ascending stage of a gonorrhea was only to be advised when no remedies existed which would destroy the gonococcus.

In the last few years, however, modern chemistry has provided us with a group of drugs which actually accomplish the conditions demanded by Neisser, and destroy the gonococci without injury to the mucous membrane.

They consist in a combination of silver with bodies from the albuminous group, are soluble in water, and not precipitated by contact with salt or albumin. They are accredited with the power of penetrating the deeper tissues and destroying the gonococci which lie underneath the mucous membrane.

The action of the silver salts is incomplete, and they do not destroy *all* the gonococci, particularly those in the mucous crypts and follicles; so that if their use is discontinued too soon, a relapse is liable to occur.

A great advantage of the treatment with silver salts, which may also be assisted by the internal use of sandal-wood oil, is that the disinfection of the tissues advances rapidly and the spread of the inflammation is checked; so that, while under ordinary treatment posterior urethritis occurs in 80 per cent. of the cases, in the patients treated with silver

salts posterior urethritis is observed in from only 30 to 40 per cent. of cases, and the disagreeable symptoms of excessive discharge, chordee, and burning on urination are very much lessened.

In point of time, while a very small percentage of cases are cured in from two to three weeks, under the treatment with silver salts, in the great majority of patients, in which complications do not occur, a continuous course of medication of five to six weeks is required, in order to effect a cure.

As the albuminates of silver all possess similar properties, albargin, protargol, and argyrol may be taken as types of the entire class.

These drugs may be regarded as pure antiseptics without astringent properties, and entirely unirritating to the tissues, so that they can be used in the ascending stage.

METHOD OF USING THE SALTS OF SILVER.

It should be borne in mind that the local treatment of acute gonorrhea is only admissible when no complications, such as severe posterior urethritis, suppurative prostatitis, vesiculitis, etc., are present.

In an uncomplicated case the injections with the salts of silver may be begun at once, in the ascending stage.

The patient should be instructed that it is important to make the injections four or five times a day and from six to eight hours apart, and before using the injection he should urinate. It may sometimes be advisable to wash out the urethra with a couple of syringefuls of warm water, to prevent any action of the urinary salts upon the silver solution, and also to cleanse the walls of the canal.

The solution of silver should be held in the urethra from five to ten minutes, in order to exert its destructive action upon the gonococci. A shorter time is insufficient and fails.

Protargol should be used in the strength of 2½ to 10 grains to the ounce; argyrol, 9 to 22 grains to the ounce, and Albargin, which is the most concentrated and is at present preferred in Germany, in the strength of 1 to 2 grains to the ounce, and 1:1000 in solution for irrigations.

The weaker solutions are used at first, and the strength is increased by degrees.

In using an injection the fluid must come in contact with the entire mucous membrane of the urethra and it must distend the bulb. The folds of the urethra must also be distended and the fluid should also press into the openings of Morgagni's crypts. To accomplish these objects the syringe must have a capacity of at least 4 drams, but Frank and Finger prefer to use an irrigator with a copious flow acting by

hydrostatic pressure, as it is very difficult to distend the bulb sufficiently and force the fluid into Morgagni's crypts with a hand-syringe. (See Janet irrigation.)

Under the use of one of the silver salts as an injection, in the course of a few days the acute symptoms subside and the pain on urination and chordee disappear. It should be noted that, if treatment be discontinued at this point, even though the discharge has ceased and only a few shreds remain in the urine, a relapse is certain to occur in from two to three weeks, for a few gonococci have been left which were not destroyed, and reinfection occurs.

With the subsidence of the acute symptoms the strength of the solution should be increased, and it may be used four times a day, in order to destroy the gonococci more rapidly.

Another advantage possessed by protargol and albargin is that, in cases where the inflammation has passed beyond the cut-off muscle and attacked the posterior urethra, on holding a solution of either drug in the urethra for a short time the cut-off muscle relaxes, on account of the mild and unirritating character of the remedies, and allows the solution to flow back and come in contact with the posterior urethra and exercise its bactericidal power.

If a strong and irritating solution, like nitrate of silver, is injected into the anterior urethra, a reflex contraction of the cut-off muscle is always caused.

In a severe case of posterior urethritis any injection is inadmissible, but the very mild form without symptoms need not be regarded as a contraindication to local urethral medication.

Under the treatment with silver salts above described, in cases which run a favorable course, in about three weeks the discharge has become thin, watery, and scanty, and microscopic examination shows few or no gonococci, but many newly formed desquamated epithelial cells.

ASTRINGENT INJECTIONS.

Our task is now to cure the existing postgonorrheal lesions, which consist in a catarrhal inflammation of the mucous membrane, erosions, periglandular infiltration, and soft infiltration of the submucous tissues.

As the silver salts have only a destructive action on the gonococci, but no effect upon the inflammatory process, it is necessary at this time to treat the existing catarrh in the mucous membrane by some remedy with an astringent action, but, as there are usually a few gonococci still remaining, often hidden in Morgagni's crypts, it is necessary to continue the antibacterial silver salt in combination with an astringent.

The silver salt should be injected twice a day, and one of the following drugs used twice a day, at a different time, as an injection:—

℞ Zinci sulphatis ..... gr. xij.
Resorcin ..... gr. xxiv.
Aquæ ..... ℥iv.

Ultzmann's Injection:—

℞ Zinci sulphatis,
Pulv. aluminis .....āā gr. iv to xij.
Acidi carbolici ..... gr. iv.
Aquæ ..... ℥iv.

℞ Zinci permanganatis ..... gr. j to ij.
Aquæ ..... ℥iv.

℞ Zinci sulphatis ..... gr. xv.
Plumbi acetatis ..... gr. xxx.
Aquæ destillatæ .....q. s. ad ℥vj.
Sig.: Insoluble. Hold in urethra, and let out drop by drop.

Syringes are of various shapes and made of soft rubber, hard rubber, and glass. An important point to observe is that the nozzle is not prolonged into a snout, which would irritate the mucous membrane of the fossa navicularis. In addition, it is essential that the syringe should hold from three to four drams of fluid, so that when the injection is given the folds of the urethra may be fully distended.

Technique of Injecting.—The patient urinates to cleanse the urethra, and then, holding the penis in the left hand, draws it out, while with the right hand the injection is slowly forced from the syringe into the urethra and held for two to five minutes. It is not necessary to make pressure on the perineum to keep the fluid from entering the bladder, as the fluid is kept from flowing backward by the tonic contraction of the cut-off muscle.

An astringent injection should never be used in the presence of posterior urethritis nor in the *ascending stage* of a gonorrhea, for, until the stage of decline sets in, the gonococci lie deep within the tissues and entirely out of reach of astringents applied to the surface of the mucous membrane. In addition to being of no value in destroying the gonococci, astringents are actually harmful from the irritation which their use entails.

In the *stage of decline,* however, when the burning on urination is decreased and the discharge has become thin and watery, the gonococci are growing upon the free surface of the mucous membrane and can be destroyed by the application of the various injections which combine an antiseptic and astringent. At the same time the dilated blood-vessels

are contracted by the astringent and the inflammation, through their agency, is lessened.

An injection should never cause more than a slight burning. After a time the urethra becomes *tolerant* of *one* form of injection, and it is necessary to increase its strength or to change the formula.

After the gonococci have entirely disappeared from the discharge, the silver salt may be discontinued and the astringent injection used alone three or four times a day.

Under this treatment the discharge soon stops and the urine becomes clear and free from pus, but *shreds* are abundant.

When the shreds appear, the urethra should be irrigated with solution of silver nitrate in the strength of from 1 : 10,000 to 1 : 4000.

If a profuse discharge appears afterward, it indicates that there are still gonococci present in the tissues, and the treatment with the silver salt must be further continued.

When no relapse follows the nitrate of silver irrigation, and the urine is clear, but contains many shreds, **Dilatation of the Urethra** should be begun, either with a full-sized steel sound or preferably with Frank's anterior irrigating dilator.

The dilatations should be made once a week, possibly once in four or five days, beginning with 27, 28, or 30. The amount of reaction and secretion following is a guide to the frequency with which the dilatations may be used.

Each dilatation should be accompanied by an irrigation of nitrate of silver, 1 : 4000 to 1 : 2000, or icthargan, 1 : 4000; or if staphylococcus, streptococcus, or the colon bacillus is present, oxycyanide of mercury, 1 : 4000, should be used.

Albargin or protargol is not called for at this stage, as the gonococci are mostly removed from the tissues and an astringent is required.

The irrigating dilatations are continued until the shreds are gone and the patient uses a hand injection of one of the astringents three times a day, and a copious irrigation of the urethra should be made every second day with nitrate of silver.

Certain individuals do not respond well to this treatment, but improve rapidly under a daily irrigation of icthargan or permanganate of potash. (Wossidlo.) Permanganate of potash is a mild antiseptic and astringent, and often acts very well in checking suppuration, although it has little or no action on the gonococci themselves.

An important question is, How long should the treatment of a gonorrhea be continued? It is not sufficient to stop medication when the discharge from the meatus ceases, for small quantities of secretion adhere closely to the walls of the mucous membrane, in thin layers, particularly

in the bulb, and are only washed off by urination, appearing in the urine as shreds. The presence of shreds always shows that the inflammatory process is still active.

It is possible to treat a gonorrhea too long, for after the gonococci

Fig. 29.—Frank's irrigating dilator, for the anterior urethra.

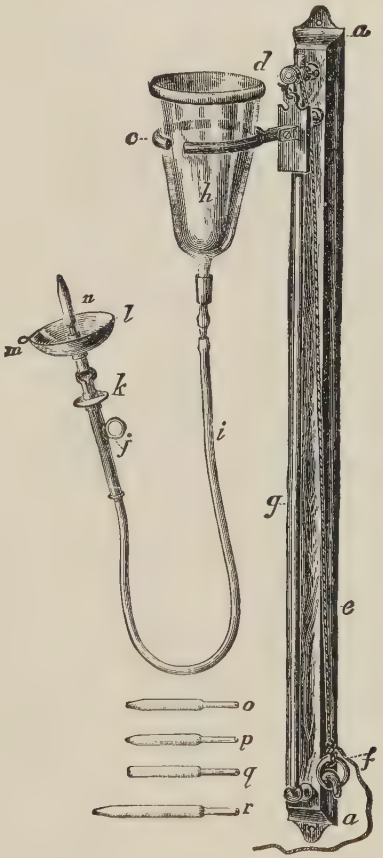

Fig. 30.—Valentine's irrigator.

have disappeared an irritable hyperemic condition of the mucous membrane is left, which is characterized by the appearance of thin, transparent shreds. The secretion which appears at the meatus causes a slight sticking together of the lips in the morning, or, on squeezing, a small, transparent drop like glycerin appears.

If the use of strong injections is continued at this stage, the condition is made worse or the discharge increases and continues as long as the irritating injections are used.

It is always advisable to stop treatment for a time to allow the irritation to subside, and often the thin mucous discharge will spontaneously disappear.

But the question of how long to continue treatment and when to stop, can only be answered by the microscopic examination of the discharge. If gonococci are present, even though few in numbers, the antibacterial treatment must, of course, be continued, and if pus-corpuscles are numerous, even though gonococci are not found, it is evident that a focus of suppuration is present somewhere, very often in one of Morgagni's crypts or one of the paraurethral glands, and a subsequent examination will probably reveal the presence of gonococci.

In such cases the antibacterial treatment should be continued, but when the microscope shows only a small quantity of pus and numerous epithelial cells treatment should be stopped, as the desquamation of epithelium is only harmfully increased by continuing. (Finger.)

After five or six weeks' treatment, if the discharge has stopped and the urine is free from filaments and the prostate and vesicles are not involved, treatment may be suspended, and if a week or ten days pass without symptoms the patient may be instructed to drink several glasses of beer.

If the beer does not cause a relapse, the patient remains for a fortnight under observation, and the urine is examined for shreds. An irrigation of the anterior urethra with nitrate of silver should be made twice, at different times, to cause an irritation, and the resulting discharge should be examined for gonococci.

If the chemical urethritis following the nitrate of silver ceases spontaneously in forty-eight hours and does not appear again, and the microscope demonstrates the absence of gonococci in the pus, and if the urine remains clear and free from shreds, the patient may be discharged as cured.

Before giving him a clean bill of health, however, it is necessary to examine the urethra with a bulb or urethroscope, and to investigate the condition of the prostate and seminal vesicles, to make sure that these organs are free from disease.

Irrigations with Permanganate of Potash: Janet's Method.—A few years ago the treatment of gonorrhea, suggested by Janet, of Paris, by means of irrigations of permanganate-of-potash solution was extensively used. Its adherents were enthusiastic in praise of its merits, Goldberg, of Cologne, citing statistics showing that 90 per cent. of the

cases of gonorrhea were cured in fourteen days by this means, but these claims as to its advantages would seem to be extravagant. According to the experience of other men who have used this form of treatment, it is impossible to attain any such results.

From the author's reading and experience with the Janet method, the following would seem to be a fair estimate of its value:—

The profuse purulent discharge is checked, in most cases, in about eight days; but even under treatment *relapses,* accompanied by a free discharge of pus, occur in nearly every case, without apparent cause, and often several times. These relapses yield promptly to irrigations of permanganate, but the convalescence is retarded, and the irrigations have to be continued daily to hold the pus in check and to control the thin, serous discharge which lasts after suppuration ceases. The course of the case is in this way dragged out; so that at least one month, and very often two months or more, are required to effect a cure.

The *advantages* of the method are that posterior urethritis is of exceptional occurrence. The discharge from the meatus is so slight as not to cause any inconvenience, and there is no burning on urination and no chordee.

The *disadvantages* of the Janet method are the expense, trouble, and inconvenience entailed upon the patient by being obliged to report at his physician's office once or twice a day for treatment.

The objection which has been raised, that the frequent irrigation of the bladder or the relaxation of the cut-off muscle will in time do harm, is, I believe, entirely unfounded.

Technique.—The patient sits easily, well forward on a chair, and rests his back against the back of the chair. The irrigator nozzle is inserted into the meatus and the anterior urethra washed out. If it is desired that the fluid should enter the bladder, the irrigator is elevated to the height of nine feet from the floor. The patient is instructed to take a long breath and attempt to urinate. As soon as the cut-off muscle is relaxed, the solution from the irrigator flows into the bladder, and when the bladder is filled the patient stands up and urinates, and the solution flows out through the urethra.

The urethra is irrigated twice a day for the first week, and then once a day till the patient is cured. The first irrigation is used of a strength of 1 : 1000 for its abortive effect, in the anterior urethra alone, and the second time of a strength of 1 : 6000. From this time on, the strength of the solution should be 1 : 3000.

As a rule, the first irrigation diminishes the secretion materially, and, when after a few days the secretion is scanty in amount and thin, the

irrigation is allowed to flow through the posterior urethra into the bladder.

After the first week one irrigation a day is sufficient, and the strength may be increased to 1:1500, unless it causes tenesmus and bladder irritation.

The effect of permanganate irrigations is to cause energetic disinfection of the mucous membrane by removing and mechanically washing away accumulated secretions, as is the case with the irrigation of any suppurating wound-cavity. The permanganate also causes an edematous swelling of the epithelial cells, which inhibits the growth of colonies of gonococci, but does not destroy them.

At the present time irrigations with permanganate of potash in the treatment of an acute gonorrhea are not used in this country as a routine measure, although in exceptional instances they are of benefit.

In France, however, the daily irrigations with permanganate of potash remain today the treatment of choice, while in Germany many genitourinary surgeons prefer the daily irrigations with albargin, 1:1000, or Hegonon, 3 per cent., which is found to be less irritating, and, as Frank points out, we are indebted to Janet for a method of bringing an antiseptic solution, such as one of the silver salts, in contact with all parts of the urethra, distending the folds and bulb, and very probably entering into Morgagni's crypts.

This method of irrigating the urethra, preferably with 1:1000 solution of albargin, is useful in the acute cases for its abortive effect, but it is especially called for in the treatment of chronic gonorrhea, after instrumentation of the urethra or massage of the prostate as long as gonococci are present.

After the gonococci have disappeared, but an infection with other organisms is present, the urethra should be irrigated with oxycyanide of mercury, 1:4000, or nitrate-of-silver solution, 1:4000.

TREATMENT OF ACUTE GONORRHEA SUMMARIZED.

The treatment of each case of acute gonorrhea differs according to the severity and stage of the disease, and it is impossible to lay down a rule which will apply to every patient.

A general outline of the treatment, however, may be summarized as follows:—

In each instance a microscopic examination of the secretion for gonococci must be made. No local treatment of the urethra by injection or irrigations is permissible when acute posturethritis, prostatitis, or vesiculitis is present until the complication has become chronic.

If a patient applies for treatment shortly after a suspicious coitus and if the discharge from the meatus is scanty, containing much mucus and epithelium, and only a few pus-cells, and but few gonococci, many of which are intracellular, the *abortive treatment* may be attempted.

In the beginning of the ascending stage with slight subjective symptoms, discharge purulent and scanty, and gonococci not very numerous, daily anterior irrigations with albargin, 1 : 1000; permanganate of potash, 1 : 3000, or hand injections of a silver salt, 4 to 6 times a day, will in a few days lessen the quantity of the discharge and diminish the number of the gonococci.

If the ascending stage is fully developed when the patient presents himself for treatment and the discharge is free, purulent, and contains numerous gonococci, but if the inflammatory reaction is not marked, the local treatment with silver salts is strongly called for.

As the urethritis improves under the silver salts, the secretion becomes watery, and the gonococci are fewer in number, an *astringent injection* should be used, alternating with the injection of the silver salt, using each one twice a day at different hours.

Finally, after the microscope shows disappearance of the gonococci the silver salt is discontinued and the astringent used alone.

If after using the silver salt for a week no improvement occurs, it is better to change the injection and use another preparation.

The same holds good of the astringent injections, and their concentration must be gradually increased as the stage of decline progresses.

As soon as the discharge has become scanty and the microscope shows numerous squamous epithelial cells, irrigations of the urethra with nitrate of silver solution, 1 : 4000, may be commenced, not so much with the object of making motile the gonococci in the deep tissues as for their antiseptic and astringent effect.

To avoid too much irritation they can only be used every second day, and in the intervals hand injections by the patient of an astringent must be continued.

If the nitrate of silver causes a relapse with free purulent discharge containing numerous gonococci, recourse must be again had to the silver salts.

Such relapses always denote a protracted course of the disease and call for a guarded prognosis as to time.

Under this treatment in an ordinary case of acute gonorrhea, at the end of the fifth or beginning of the sixth week the discharge has entirely ceased, the urine is free from filaments, and the treatment may be stopped.

The patient is advised to drink several glasses of beer. If no relapse follows he is kept under observation for at least two weeks. During this time his urine is examined for shreds, and a provocative irrigation of the urethra with silver nitrate, 1 : 1000, is made twice, purely for diagnostic purposes and with no therapeutic object.

If no gonococci are found in the resulting secretion, which ceases spontaneously in forty-eight hours, and if the urine remains clear and free from shreds, an examination of the prostate and seminal vesicles is made and the urethra explored with the urethroscope or a bulbous bougie, and if no lesions are discovered the patient may be discharged as cured.

If in the sixth week the discharge has not entirely ceased or the condition is made worse by the beer and provocative nitrate of silver irrigation tests, the case must be treated as described in the chapter on Chronic Gonorrhea.

In the fifth week dilatations of the anterior urethra with a large-sized sound or irrigating anterior dilator of Kollman have a very favorable action, provided that the clinical picture is that of a subacute chronic urethritis.

The presence of a small number of gonococci in the secretion is not a contraindication to dilatation.

CHAPTER IV.

POSTERIOR URETHRITIS.

Posterior urethritis consists in an inflammation of the mucous membrane of the posterior urethra, which lies behind the cut-off muscle. In severe cases the inflammation may extend up out of the urethra and involve the base of the bladder.

Acute posterior urethritis is almost always caused by the extension of a gonorrheal or simple urethritis from the anterior part of the canal; but the *subacute and chronic forms* may be the result of prolonged congestion from sexual abuses, complicated by germ infection from the rectum or from without.

Posterior urethritis is a serious complication of gonorrhea, because

I. It increases the extent of the inflamed surface and renders recovery more remote.

II. On account of *complications,* which are almost sure to follow, if the pus is conveyed through the various ducts opening into the posterior urethra, to the prostate, seminal vesicles, testicles, and bladder.

Posterior urethritis occurs in 40 to 80 per cent. of cases of gonorrhea, but is often so mild as to be overlooked. It usually develops from the second to the fourth week, or when the gonorrheal inflammation has extended to the bulb. It may be excited by the use of a sound or catheter in an acutely inflamed urethra, which pushes the pus along in front of the instrument or causes traumatism, or it may develop spontaneously.

The membranous urethra, in certain cases, acts as a barrier to the spread of an inflammation from the anterior urethra backward toward the bladder. The cut-off muscle, which surrounds the membranous urethra, is in a state of tonic contraction, and acts like a valve, and the mucous membrane lining the membranous urethra is less vascular and provided with fewer crypts and follicles than either the anterior or posterior urethra, and also serves to check the extension of the gonorrhea.

Clinically two forms of posterior urethritis are met with: (*a*) **mild or subacute form;** (*b*) **severe form.**

SYMPTOMS.

The symptoms of the **mild form** may be so slight as not to attract attention. There is an ill-defined sense of weight over the pubes and a feeling of pressure in the perineum, together with slightly increased frequency of urination.

The symptom of increased frequency of urination depends upon the fact that, in a condition of health, the posterior urethra is the most sensitive part of the canal, and, when the bladder becomes filled and a few drops of urine trickle into the posterior urethra, their presence sets up a certain physiological irritation, which is transmitted to the bladder, and produces a contraction of its muscular walls, which empties the bladder of its contained urine.

In posterior urethritis there is a congested state of the prostatic urethra and an abnormally acute sensitiveness; so that the stimulus to urinate is greatly increased.

In the **severe form** of posterior urethritis the symptom of frequent and painful urination is very much aggravated. If the inflammation is very acute and particularly if it has extended to the base of the bladder, violent vesical tenesmus sets in, which the patient cannot restrain.

The squeezing together of the inflamed surfaces, by the muscular contractions of the bladder, not only causes intense pain, but also often ruptures some of the capillaries in the mucous membrane; so that a few drops of blood generally follow the act of urination.

No sooner has one spasmodic contraction of the bladder subsided than another one sets in, and these continue to recur every few minutes until the suffering becomes almost unbearable.

DIAGNOSIS.

The diagnosis of the **severe** form of posterior urethritis can usually be made from the symptoms alone, but the **mild** form is apt to be overlooked, unless we direct our patient with gonorrhea to urinate in two glasses, each day we see him, and in this way we can detect inflammation of the posterior urethra in its incipiency.

The **two-glass urine test,** as devised by Sir Henry Thompson, is based upon the physiological action of the cut-off muscle, which, by its tonic contraction, forms a barrier between the anterior and posterior urethra. Fluids injected into the anterior urethra cannot flow back into the bladder, and pus lying in the posterior urethra is prevented from flowing out through the anterior urethra, but escapes backward into the bladder, and renders the urine which had accumulated in the bladder turbid and cloudy.

If suppuration is going on in the anterior urethra (the posterior urethra being healthy), and the patient is directed to urinate, the first gush of urine washes out the pus, and the urine, if caught in a glass, appears turbid. If the remainder of the urine, which had collected in

the bladder and is uncontaminated, is passed into another glass, the urine in the *second* glass is clear.

If suppuration is present in *both* anterior and posterior regions of the urethra, the *first* glass of urine passed is, of course, turbid, from the pus washed out of the urethra, and the *second* glass will be *turbid also,* because the pus formed in the posterior urethra flowed back and stained the urine which was contained in the bladder.

Turbidity of the urine is sometimes caused by urates or phosphates. If uratic in origin, the cloudiness clears up on boiling, and, if phosphatic in character, a few drops of nitric or acetic acid will render it clear. The presence of pus can be determined by microscopic examination or by adding a few drops of liquor potassæ to the suspected urine, in a test-tube, and twirling it rapidly. If pus is present it will be coagulated and float in long, ropy strings through the urine.

Chemical examination shows more albumin than can be accounted for by the pus. This superabundance of albumin is not occasioned by structural changes in the kidney, but by increased intrapelvic pressure, caused by the frequent and severe muscular spasms of the bladder.

In nearly every case of posturethritis developing in the course of a gonorrhea, rectal examination will show that the prostate is more or less affected; and after the inflammation has disappeared from the posterior urethra, foci of disease remain in the prostate, causing exacerbations of the gonorrhea and sexual neurasthenia.

In every case of gonorrhea which lasts an unusually long time and when the second glass of urine is constantly or intermittently turbid, and the pus contains gonococci, the prostate will almost invariably be found to be affected.

By rectal palpation, it will be noted that the prostate is swollen, doughy in consistence, and with scattered spots of softening. On expressing the contents with the finger, a quantity of pus, frequently containing gonococci, is forced out.

This examination is important and should never be omitted, as a large number of cases of latent and chronic gonorrhea, which after slight excesses show exacerbations, with pus and gonococci in the secretions, are dependent upon chronic prostatitis. (Frank.)

TREATMENT OF THE MILD FORM OF POSTERIOR URETHRITIS.

The irrigation of the urethra and the bladder by means of an irrigator, after Janet's method, is particularly adapted to cases of inflammation of the posterior urethra developing in the course of a

gonorrhea. There are three methods by which the posterior urethra and bladder may be irrigated:—

A. By the Janet method, with an irrigator and hydrostatic pressure.

B. By means of a large syringe with a removable soft-rubber tip.

C. By introducing a soft-rubber catheter beyond the cut-off muscle, so that its eye lies in the posterior urethra, and injecting solutions through it.

Methods A and B are to be preferred and are in most general use, as the resistance of the cut-off muscle is easily overcome and the anterior and posterior urethra are irrigated thoroughly and the bladder filled.

The solutions to be used are albargin or protargol for the first few days, and as much longer as the process is acute or gonococci are present, and later on, after the process becomes subacute, nitrate of silver solution, from 1 : 10,000 to 1 : 4000, should be employed.

If the prostate is found to be diseased at the same time that posterior urethritis develops, its progress should be closely watched, and as soon as the acute condition has subsided, massage should be begun and continued until such time when no more pus can be expressed, but only a small quantity of secretion of an epithelial character.

Instead of using copious flushings of the urethra, with a considerable quantity of fluid, we can deposit a few drops of a concentrated solution of nitrate of silver directly upon the surface of the mucous membrane by means of Ultzmann's syringe. This syringe is introduced past the cut-off muscle, so that the end lies in the posterior urethra, and 15 or 20 drops of the solution are injected. Nitrate of silver, in strength ranging from 1 to 5 grains to the ounce, is the best application for the purpose.

If we desire to medicate the posterior urethra alone, the patient should retain some urine in the bladder. The urine will neutralize the solution as it flows into the bladder. If a urethrocystitis be present, the patient should *empty* his bladder first, and the injected fluid will then medicate the posterior urethra and flow back and affect the base of the bladder as well.

As to a selection between the methods of irrigation and instillation, as a general rule, it is found that recent cases with an abundant purulent secretion and which are free from pain or other acute symptoms are most benefited by copious irrigations, and that after the discharge has diminished, so that the urine is clear and only shreds are present, instillations are more serviceable.

Diuretics—such as triticum repens, uva ursi, buchu, etc.—are not indicated in posterior urethritis, since, although they render the urine bland and unirritating, they increase the quantity secreted, and occasion more frequent calls on the bladder to empty itself.

TREATMENT OF THE SEVERE FORM OF POSTERIOR URETHRITIS.

In this form any kind of mechanical interference with the urethra —such as injections, irrigations, or the introduction of any instrument— should be *rigidly avoided*. The patient should go to bed in order to secure rest for the inflamed posterior urethra, lessen its congested condition, and so diminish the vesical tenesmus.

A mild saline cathartic is useful by reducing the congestion of the pelvic organs. Milk should be the staple article of diet, to render the

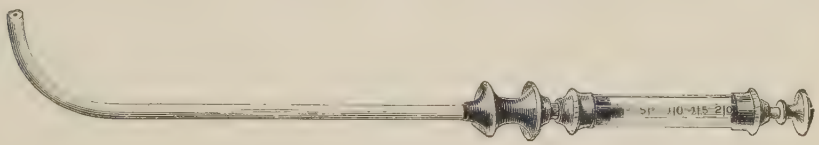

Fig. 31.—Ultzmann's syringe.

urine bland and unirritating. *Sandal-wood oil* acts almost like a specific in some cases. After a few doses the tenesmus lessens and the escape of blood after urination ceases.

Alkalics or *alkaline mineral* waters are contraindicated, for the reason that the urine in the bladder is necessarily neutral or alkaline in reaction, on account of the abstinence from meat and the milk diet ordered. If the urine becomes alkaline and pyogenic micro-organisms make their way into the bladder from without, a suppurative cystitis is almost sure to occur; so that a moderate degree of acidity of the urine is regarded as the best prophylactic against cystitis.

In order to maintain this condition of acid urine, it has been advised of late to administer *salicylate of soda,* gr. xx three times a day, as this drug has the property of causing a strong acid reaction in the urine.

Morphine is generally required to relieve the excessive tenesmus and allay the frequent desire to urinate. The frequent desire for urination has a bad effect upon the inflammation, since the contractions of the bladder cause an increase in the hyperemia at its base. Morphine may be given by the mouth, but preferably in suppository.

Hot sitz-baths prolonged for half an hour and used several times a day sometimes lessen the tenesmus and desire to urinate; but, while useful as an adjuvant, they will hardly take the place of opium.

When these methods fail to relieve the tenesmus and pain, which may be intense, the **instillation** of 10 drops of nitrate of silver with an Ultzmann syringe into the posterior urethra often succeeds in calming the disturbance in a few hours. It is desirable to begin with gr. j to the ounce and increase up to gr. v to the ounce, using it every second or third day.

It is always better to use the instillation as a last resort, since we can lay it down as a rule from which there are few departures: "Never to introduce an instrument into a urethra affected with *acute* inflammation."

After acute symptoms have passed off, the case assumes the characteristics of the *mild* form of posterior urethritis, and can be treated as such.

RÉSUMÉ OF THE TREATMENT OF ACUTE GONORRHEA.

Abortive Treatment.—*Favorable Cases.*—In commencement, gonococci scanty and extracellular; much epithelium; few leucocytes. Daily irrigations, albargin 1 : 1000.

Methodic Treatment of Ascending Stage.—*Examination.*—Microscopic: Pus abundant; gonococci intracellular. Urine, glass 1 turbid, glass 2 clear.

Treatment.—Sandal oil internally. Injection of silver salt three times a day, albargin, protargol, or argyrol.

Stage of Decline (third week).—*Examination in Early Period.*—Microscopic: A few pus-cells, few gonococci; many squamous epithelial cells. Urine, glass 1 turbid, glass 2 clear.

Treatment.—Injection of silver salt continued, also begin astringent injection.

Later Period.—*Examination.*—Microscopic: Few pus-cells, epithelial cells, no gonococci. Urine, glass 1 clear, shreds present.

Treatment.—Irrigations of urethra, nitrate of silver 1 : 10,000 to 1 : 4000.

(*a*) If relapse with gonococci follows, continue silver salt and astringent.

(*b*) If no relapse follows, irrigating dilatations with the Frank-Kollmann dilator or sound. Irrigations with nitrate of silver, icthargan, or oxycyanide. Hand injections with astringent.

Anterior Urethritis Complicated by Posterior Urethritis.

(*a*) Subacute form.
(*b*) Severe form.

(*a*) *Subacute Form.*—Symptoms almost unnoticeable. Urine, glass 1 turbid, glass 2 turbid. Suspect prostatitis.

Treatment.—Sandal oil internally. Irrigation, albargin or nitrate of silver, or instillations of nitrate of silver.

(*b*) *Severe Form.*—Symptoms, fever, tenesmus, terminal hematuria, and pyuria. Urine, glass 1 turbid, glass 2 turbid, possibly blood. Suspect prostatitis and vesiculitis.

Treatment.—Rest in bed, milk diet. Sandal oil or sodæ salicylat and opium. Hot sitz-baths. Hot-water irrigation of rectum. No instrumentation or injections.

COMPLICATIONS OF ACUTE GONORRHEA.

CHAPTER V.

Peracute Urethritis.—In a few cases of gonorrhea the inflammatory symptoms run very high.

The prepuce and skin of the penis are red, inflamed, and very much swollen. The discharge is profuse, the burning on urination is intense and painful, erections are frequent and difficult to control.

In such cases all local treatment by injections and irrigations is absolutely contraindicated.

The patient should be put to bed, kept on a restricted diet, and lead and opium wash applied to the penis.

The expectant treatment is continued until the severity of the symptoms has abated and the case has assumed the characteristics of an ordinary gonorrhea, when it may be treated in the usual way.

Severe Burning on Urination is a source of great discomfort to the patient.

It may be moderated often by the administration of sandal-wood oil.

When this fails, the patient should drink freely of mucilaginous drinks, such as flaxseed tea or infusion of uva ursi.

Wossidlo recommends that limited quantities of water should be drunk, in order to lessen the volume of urine.

A 2 per cent. solution of eucaine may also be injected into the urethra before urinating.

Retention of Urine may arise as the result of the congestion occurring about an old stricture and closing its lumen entirely, or it may be due to a spasmodic contraction of the cut-off muscle, or a complicating prostatitis.

Retention is frequently relieved by the administration of a full dose of opium and a prolonged hot bath, but when these measures fail it is necessary to introduce a catheter, after first washing the urethra most carefully with albargin solution, 1 : 1000, to rid it of pus and prevent infection of the bladder.

Balanitis is an inflammation of the mucous membrane of the prepuce and glans penis, and is apt to occur in men with a long foreskin, and particularly in persons of uncleanly habits.

The *treatment* consists in cleanliness, the use of a dusting powder, and preventing contact of the apposing surfaces of mucous membrane by means of cotton packed between the foreskin and the glans. Occasionally the edema and swellings are so great that the foreskin cannot be retracted, giving rise to a condition of phimosis.

Phimosis.—This should be treated by prolonged soaking of the penis in hot water and the use of an antiseptic injection thrown in under

Fig. 32.—Paraphimosis complicating gonorrhea.

the foreskin with a flat-billed Taylor syringe. In the event of gangrene threatening or when the swelling and edema persist, the operation of circumcision or making an incision through the foreskin upon its dorsum is called for. If chancroids are found under the prepuce after operation, they should be cauterized as well as the freshly made wound.

Paraphimosis is that condition in which a long and tight foreskin is caught back behind the glans and cannot be retracted over the head of the penis.

The *treatment* consists in bringing the foreskin back into its proper place by manipulation. If this proves difficult or if the glans looks gangrenous, the constricting band should be incised on the dorsum, which will generally allow reduction to be effected.

Folliculitis consists in suppuration of one of the urethral follicles, with retention of the pus, forming a small abscess, which, if left to itself, opens spontaneously either into the urethra or through the skin.

The *treatment* consists in laying the abscess-cavity open freely, as soon as fluctuation is noticed, evacuating the pus, and allowing it to heal by granulation.

Fig. 33.—Periurethral abscess, beginning as a folliculitis. (Author's case, from the Polhemus Clinic.)

Cowperitis is a suppurative inflammation of Cowper's glands, and should be treated in the same way as folliculitis.

Inguinal adenitis is an inflammatory enlargement of the lymphatic glands in the groin, which is generally present in gonorrhea. The glands rarely suppurate, but usually undergo resolution.

The *treatment* consists in rest, hot or cold applications, and pressure. If suppuration occurs, it should be treated as a bubo. (See Bubo.)

Chordee is a complication which adds greatly to the discomfort of a patient with gonorrhea. It is due to the plastic infiltration which

takes place into the meshes of the corpus spongiosum, and renders it so rigid and inelastic that it cannot become elongated during erection, but draws on the corpora cavernosa, and bends them down, like the tightened string bends a bow.

Treatment is directed toward preventing these painful erections and allowing the patient to sleep undisturbed. To this end he should use prolonged immersions of the penis in very hot water before going to bed, and should sleep in a cool room, lightly covered. It is better for him to sleep on the side, as the dorsal decubitus favors congestion of the center of erection in the cord.

A towel tied around the waist with a knot in the middle of the back will assist in this, for if the patient lies on his back the knot will press into the flesh and waken him.

In severe cases these measures are not enough, and it is necessary to administer sedative drugs. Lupulin, gr. xxx-xl at bedtime; bromide of potash in large doses, 30 grains in the afternoon and again at bedtime, or monobromide of camphor in 5-grain doses will sometimes answer, and, when they do not, opium must be used, preferably by suppository.

When the patient wakes with the penis erect and painful, he should immerse both penis and testicles in a basin of hot water, or, if that is not at hand, cold water will answer the same purpose, and he should also empty his bladder.

"Breaking the chordee" leads to violent hemorrhage and ultimately to severe traumatic stricture.

Epididymitis, or inflammation of the head of the testicle, is not a result of metastasis through the blood-vessels or lymph-channels, but is caused by the passage of gonococci from the posterior urethra to the epididymis by way of the seminal vesicles and vas deferens.

The body of the testicle proper is not involved, as a rule, and the inflammation is limited to the epididymis, but the testicle is often *apparently* enlarged on account of its being surrounded by the swollen and inflamed epididymis. Another element which causes the testicle to appear larger than normal is the effusion of serum which takes place into the sac of the tunica vaginalis, and causes hydrocele. This may, in time, be absorbed or remain permanently and increase.

The *symptoms* are always well marked. There is severe pain in the testicle, radiating up into the abdomen. The patient's gait is characteristic; he bends over as he stands, and walks with his legs straddling in order to relax the spermatic cord and relieve it from the weight of the enlarged testicle.

The purulent discharge of the gonorrhea generally ceases at once, and remains absent until the inflammation in the epididymis is better, and then the discharge begins again, only not so profusely as before.

On examining the testicle we find the epididymis enlarged, hard, and tender, and the testicle cannot be readily outlined on account of the effusion of serum into the sac of the tunica vaginalis. The spermatic cord is thickened and very tender. The inflammatory products disappear by resolution and rarely suppurate.

If both epididymes have been affected, a condition of *sterility* may be left, which is permanent. The function of the testicle may be destroyed in three ways:—

I. The most common is the formation of an inflammatory infiltrate in the head of the epididymis, which is not absorbed, but remains and forms a plug, blocking up the efferent duct.

II. An atrophy of the glandular structure of the testicle may occur, probably as a result of inflammatory products in its substance.

III. In very exceptional cases the body of the testicle suppurates and sloughs out, and in this way the organ itself may be entirely destroyed.

Tubercular disease of the testicle occasionally follows a gonorrheal epididymitis, and is due to the lighting up of a focus of tubercular material which had been unsuspected and dormant in the epididymis.

Treatment.—If seen within the first few hours, the severity of the inflammation may be lessened by applying three or four leeches along the spermatic cord. The patient should, of course, be put in bed and the testicles supported by means of a Curling handkerchief bandage.

Hot applications are to be preferred rather than the ice-bag, although ice was at one time very popular. While the ice subdues the inflammatory symptoms promptly, its use is very apt to be followed by a hard, tough infiltration in the epididymis, which is never absorbed, but remains, blocking up the epididymis and causing sterility. Another disadvantage of ice is that atrophy of the testicle is more apt to occur in cases where it has been used.

The hot applications can be used in the form of hot lead-and-opium wash or flaxseed poultices.

A favorite treatment in France consists in applying a salve to the inflamed testicle, composed of

℞ Guaiacol ..... 20 per cent.
Lanolin,
Resorbin ..... equal parts.

This should be covered with cotton, with a layer of wax-paper or oil-silk on the outside. A thermophore, hot-water bag, or hot fomentations are then applied outside the dressing.

The guaiacol ointment usually allays the pain promptly and should be changed three times a day. At the time of changing the dressing the patient should take a hot sitz-bath for half an hour. The guaiacol ointment should be continued as long as the pain lasts, and after the skin is eroded it should be brushed over with nitrate-of-silver solution, 10 per cent., and dressed with fluidext. hamamelis.

Severe cases may be treated advantageously with peat fomentations and the pain may be relieved by antipyrin or morphine.

The bowels should be kept freely open by salts and an enema given every morning. Under this treatment it is said that a hard mass does not remain unabsorbed in the epididymis, causing sterility.

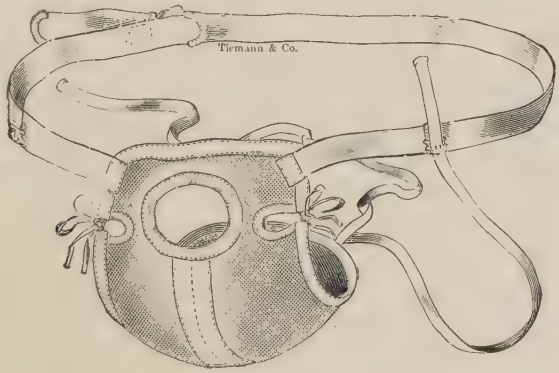

Fig. 34.—Horand-Langlebert suspensory bandage.

In cases where a great deal of effusion has taken place into the cavity of the tunica vaginalis, it is desirable to relieve the tension promptly by drawing off the fluid with an aspirating needle.

In cases of epididymitis which are not very severe, the Horand-Langlebert suspensory bandage, lined with a thick pad of cotton-batting, fills the indications of rest, warmth, and suspension, and at the same time permits the patient to walk about without pain.

After the patient is out of bed and begins to go about, he should continue the use of the suspensory bandage, and keep the testicle well enveloped in cotton.

It is the custom to use ointments designed to stimulate absorption. The one which is most commonly employed is:—

℞ Ichthyol ..... ʒj.
Lanolin,
Vaselin .....āā ʒss.
M. Sig.: To be applied constantly on lint to testicle.

Iodide of potash given internally is of no use in producing absorption of the inflammatory products.

The *Paquelin cautery* is sometimes used by brushing it lightly over the surface of the skin of the scrotum and burning or searing it very superficially. In the beginning of the disease it has the effect of allaying pain, and later on produces absorption of the inflammatory products.

In order to prevent sterility it is important to *promote the absorption of the newly formed tissue in the epididymis.*

In recent cases while the infiltrate is soft this may be accomplished by a sort of massage or kneading of the infiltration between the thumb and finger; but in cases of long standing, when the infiltration has become hard and dense, all such attempts are unsuccessful.

At the time that the zinc salts were used as injections in gonorrhea it was the practice to stop local treatment as soon as epididymitis developed, and not begin again until it was entirely cured.

Since the introduction of the silver salts, however, this rule no longer absolutely applies, and in cases where the inflammation is not too severe, the urethral injections of albargin or protargol may be continued without cessation, even though the testicle is swollen. (Frank.)

In order to prevent the development of an epididymitis in cases of chronic gonorrhea or enlarged prostate, after instrumentation of the urethra or massage of the prostate, Frank advises a thorough irrigation of the urethra before and after instrumentation, in order to rid the canal of organisms which may otherwise make their way through the ejaculatory ducts and vas deferens to the epididymis.

By following this plan he finds a marked diminution in the number of cases which develop in the course of treatment.

TREATMENT OF GONORRHEAL EPIDIDYMITIS BY SURGICAL OPERATION.

The great majority of cases of inflammation of the epididymis, due to extension of the gonorrheal inflammation from the urethra through the vasa deferentia, go on to more or less complete resolution under an expectant treatment. The resolution, unfortunately, is often not complete, and a deposit of fibrous tissue is left at the head of the epididymis which compresses its tubules, blocking the passages and preventing the exit of the spermatozoa which are formed in the testicle. In consequence, sterility of the testicle on that side results, and in case of a double epididymis complete sterility is often the outcome.

While the pain in most cases of gonorrheal epididymitis is usually controlled by hot applications and rest in bed, it is not very unusual to meet with a case where the inflammatory reaction is so severe that in

spite of large doses of opium the pain is unbearable. The temperature runs to 103° or higher, and, while the inflammation gradually subsides after a period of great suffering for the patient, the subsequent function of the testicle on the affected side is usually permanently destroyed.

It is to this class of severe inflammation of the epididymis that the operation about to be described is applicable.

The treatment of gonorrheal epididymitis by incision and puncture is by no means a new idea. It was done by Pirogoff in 1852, and also by Vidal de Cassis, and, in 1864, H. Smith reported in the *Lancet* one thousand cases of epididymitis treated in this way.

The operative treatment seems then to have fallen into entire disuse, except in cases where a considerable quantity of fluid accumulated in the sac of the tunica vaginalis. In these acute hydroceles it has been customary to aspirate or draw off the fluid with a trocar, and the relief of the tension was always followed by great lessening of the pain.

To Francis R. Hagner,[1] of Washington, belongs the credit of developing and applying the operation which, in his hands and that of the writer, has lessened the severity and shortened the course and probably preserved the integrity of the testicle in the severest forms of gonorrheal epididymitis.

As before stated, it is necessary only in the most exceptional cases, where the pain is excessive and the temperature runs high; the others are amenable to ordinary medical treatment.

The operation is performed as follows:—

The patient is prepared for a major operation and then anesthetized. The use of cocaine is not practicable because of the pain occasioned in handling the parts after the initial steps.

An incision is made through the skin of the scrotum, exposing the tunica vaginalis, which is opened at the junction of the epididymis and testicle. The fluid contained is evacuated, and the enlarged epididymis examined through the wound. The testicle and epididymis are delivered through the wound and enveloped in warm towels. Multiple punctures are made through the fibrous covering of the epididymis with a tenotome, especially over the portions where the enlargement and thickening is greatest. The knife should penetrate the thickened fibrous capsule and enter the infiltrated connective tissue; a decided lessening of resistance is felt after the knife has penetrated the thickened covering of the epididymis.

If pus is seen escaping from any of the punctures, the opening should be enlarged and a small probe inserted in the direction from which the

[1] Transactions American Association of Genito-urinary Surgeons, 1907.

pus flows. The insertion of a probe is attended with less danger of injuring the tubes of the epididymis than if a knife were used.

After the small abscess has been explored with a probe, the pus should be evacuated by light pressure over its surface, and its cavity washed out with a fine-pointed syringe and a solution of bichloride of mercury, 1 : 1000, followed by a normal salt solution.

The incision in the tunica vaginalis should be lightly closed with a running catgut suture; a cigarette drain of gauze is then applied over the incision, and the skin brought together by a subcutaneous suture. Gauze dressings are applied and the part supported by a wide T-bandage.

The second day after the operation the gauze drain is removed and the wound redressed, and, as a rule, the patient is allowed to get out of bed and walk about a week after the operation.

In several of the cases the writer operated upon, the testicle and sac, instead of being freely movable, were bound firmly to the scrotum by means of firm, newly formed adhesions.

Invariably the sac of the tunica vaginalis has been filled with enough fluid to cause a good deal of distention.

In one case there was but little free fluid, the entire sac being filled with a sort of false membrane or effusion of plastic lymph.

The spermatic cord was thickened and the epididymis very much enlarged, more especially at the head. The engorged vessels could be seen coursing over the epididymis, and its color was of a dark purple; occasionally the pressure from the distention was so great that a white bloodless area the size of a finger-nail could be seen at its extremity.

In four instances collections of pus, two of which contained gonococci, were found in puncturing the epididymis.

The finding and evacuation of collections of pus in the epididymis is a sufficient warrant for the performance of an operation, for it is only following out the surgical axiom of giving free vent to collections of pus which are closed up. The operation also clears up an erroneous impression which has prevailed, to the effect that gonorrheal epididymitis did not suppurate and only caused an adhesive inflammation.

In the 7 cases operated upon by the writer the pain was relieved at once and was never felt again. A drop in the temperature almost to the normal point occurred immediately, and the temperature soon became normal and remained there.

In all the cases but 2 the patient was able to get out of bed and walk about the ward, without discomfort, in one week's time.

The time required for an entire return of the testicle to its normal size, and the disappearance of all traces of infiltrate in the head of the epididymis, varied considerably. Two cases were lost sight of, but with

the others it required, respectively, five, six, eight, and ten weeks for the parts to be entirely restored to normal conditions; but it must be remembered that these cases were all exceptionally severe, and that resolution would have been still more delayed under an expectant plan of treatment.

Gonorrheal rheumatism is an inflammation of one or more joints occurring in the course of a gonorrhea and due to the direct action of the gonococcus. The gonococci are carried through the blood-current,

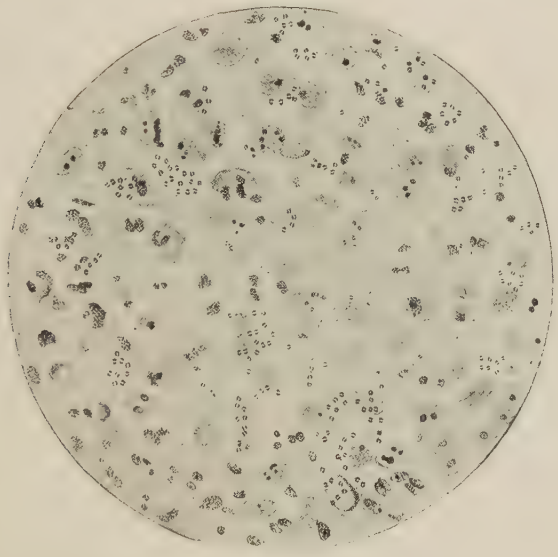

Fig. 35.—Gonorrheal rheumatism. Synovial membrane infiltrated with numerous intracellular gonococci. (From "Die Syphilis und die Venerischen Krankheiten," von *Dr. Ernest Finger.*)

and are deposited in various joints, where they set up an inflammation in the synovial membrane lining them.

If the gonococci alone are deposited in the joint, the resulting inflammation causes an excessive secretion of serum, and a simple *hydrarthrosis* results, or the inflammation may attack the synovial sheaths of tendons and the bursæ, occasioning a chronic thickening, with ankylosis of the joints from the formation of connective tissue. These cannot be successfully operated upon afterward, and the joint remains permanently stiffened.

Suppurative inflammations of the joint are due to a mixed infection; in addition to the gonococci, staphylococci and streptococci are the exciting causes.

Clinically we can distinguish three forms of gonorrheal rheumatism:—

(*a*) *Hydrarthrosis,* which is usually confined to a single joint (monarticular), and is generally the knee.

(*b*) Resembling ordinary rheumatism, since it begins with fever, and several joints are involved.

(*c*) The synovial sheaths of tendons and muscles and the bursæ are attacked and become the seat of chronic inflammatory changes. The joints may be involved or may escape.

The course of all forms is very slow, and recovery is always protracted.

Pericarditis and endocarditis also frequently occur, with ulcerations of the valves and the formation of deposits upon them, which contain gonococci.

Treatment.—It is of essential importance to treat the gonorrhea, which almost always affects the posterior urethra or its adnexa.

In the cases which begin with active symptoms—high fever, rapid pulse, and the affection of several joints—salicylate of soda acts well, but in a case which is insidious in its beginning and turns out to be a slow, chronic synovitis, giving rise to hydrarthrosis, the salicylates are of little use.

Iodide of potash given in increasingly large doses, even as high as 3 or 4 drams a day, is sometimes of more benefit than anything else. Salol and oil of gaultheria are also sometimes of use.

The *local treatment* is important. The inflamed joint should be put at rest by keeping the patient in bed and applying a light splint to immobilize it. If much heat, redness, and swelling are present, an evaporating lotion or an ice-bag is in order.

In the last few years two valuable therapeutic measures have been introduced into practice, viz.: Bier's hyperemia and the vaccine therapy.

The **Bier hyperemia treatment** is based upon the physiological point of view that an inflammation in itself does not represent a diseased condition, but is a phenomenon showing the body's attempt to resist a deleterious invasion.

The aim of the Bier hyperemic treatment is to increase this beneficent inflammatory hyperemia resulting from the fight of the living body against invasion.

The most important principle underlying the treatment is that the blood must continue to circulate; there must never be a stasis.

As soon as the diagnosis of gonorrheal arthritis is made, the hyperemia treatment should be begun, and, the earlier the treatment is started, the better is the result.

Method of Application.—Obstructive hyperemia of the extremities is produced by means of a soft-rubber bandage two and a half inches wide

applied around the limb, on healthy tissue, proximal to the seat of disease after all dressings have been removed, six or eight times, one layer overlapping the other firmly enough to slightly constrict the lumen of the thin-walled veins, but not sufficiently to compress the more resistant arteries.

The shoulder, however, can be made hyperemic by means of the following special technique (Willy Meyer): A compress of gauze is folded and tied loosely around the patient's neck. Through its loop a piece of strong rubber tubing is pushed and conducted underneath the axilla around the shoulder. Then the tubing is clamped or tied on top of the shoulder, a piece of bandage is tied on to the rubber tubing—one in front, another behind—the two ends being joined in the opposite axilla.

If a marked degree of venous congestion is desired, the bandage is applied rather tightly; if, on the other hand, only a slight congestion is desired, the bandage is applied so that only a slight amount of pressure is exerted. If the bandage is applied about the limit snugly to produce a marked hyperemia, the limb within a few minutes shows signs of venous congestion: it feels fuller, the veins stand out, and the skin becomes bluish. Hyperemia of this marked degree is never borne, with comfort, for more than one to two hours at a time. If, however, one desires a much milder hyperemia the bandage is applied less snugly and the parts show less engorgement. Now the limb becomes, instead of bright blue, a bright red or at times tinged with blue. This form of bandage may be worn with comfort by the patient for the greater part of the day.

Edema.—With both methods of application, the parts become edematous. With the milder method the swelling is more marked. This edema has to be kept within proper limits, and be reduced before the reapplication of the bandage. For this reason the treatment for the twenty-four hours is divided into two periods. During the intermission, following the application of the bandage for short periods, one to two hours, the edema always becomes absorbed. However, in cases of long-continued hyperemia ten to eleven hours, out of every twelve, in which, therefore, the time for absorption is short, the extremity should be elevated.

In acutely infected cases the rapid absorption of the inflammatory edema is often followed by some elevations of temperature which is of short duration.

Duration of Treatment.—Acute cases require prolonged applications of the bandage, with the milder degree of venous obstruction. Usually two periods in twenty-four hours, of five to eleven hours each, depending upon the acuteness and severity of the disease.

Chronic cases require shorter periods of treatment. Usually two periods in twenty-four hours of one to two hours each.

Passive motion is started as soon as lessening in the amount of pain will permit. This method of treatment has been so successful in the treatment of gonorrheal rheumatism in the Long Island College and Kings County Hospitals that it is now used as a routine.

With a correct technique the pain present in an acutely infected joint will be relieved in a few hours.

It has been observed that the first application is not as well borne as the succeeding one, due to the tendency to make the bandage too tight. The patient's own feelings are the best guide, for the degree of obstructed hyperemia (mild type) is a correct one, if the patient is not in the least annoyed by the bandage applied. As soon as the latter unduly contracts, paresthesia will be noticed in the part subjected to hyperemia; then pain sets in. If applied too loosely a mere obstruction to the return of lymph is produced, the accumulation of which alone is not wanted. The portion distal to the bandage must appear bluish or bluish red, never white; always warm, never cold.

The gonococcus vaccine has in this class of cases its greatest field of usefulness, and should be used in connection with the Bier hyperemia.

An autogenous vaccine may be prepared, but it is simpler to use a stock vaccine from some reliable maker. Fifty million bacteria may be injected subcutaneously as an initial dose. Usually there is but little reaction in the way of rise of temperature, and for the subsequent doses, which may be repeated three times a week, the full dose at one hundred million bacteria may be used.

Under the continued effects of the Bier hyperemia and the vaccines, in the course of a few days the pain is relieved and the case becomes chronic. The treatment with the vaccines and the hyperemia should still be continued, but the clinical picture has changed and the special indications for treatment at this stage are:—

I. *To produce absorption of the watery effusion in the joint.*

The most powerful agent, to this end, is *blistering,* and it should be applied on different parts of the skin over the joint, and used often enough to keep the surface raw for a considerable length of time.

Ichthyol ointment, of 50 per cent. strength, is sometimes useful as an absorbent. In all chronic cases when the patient walks about *pressure* over the joint by means of a rubber bandage should be applied, and this may serve as a substitute for blistering when the amount of fluid is slight.

It was formerly recommended, when in spite of treatment the fluid did not disappear, to aspirate the joint, draw off the fluid, and irrigate

with a solution of bichloride of mercury. This plan of treatment can only be condemned, as the risk of causing a permanently ankylosed knee-joint is too great to warrant the procedure.

After the effusion in the joint has been absorbed, or in those cases where the disease has attacked the synovial sheaths and fibrous structures about the joints, the indication is:—

II. *To cause absorption of the inflammatory deposit, which has taken around the bursæ, tendons, and synovial sheaths.*

This can be best accomplished by massage, which should be begun as soon as the patient can tolerate it, and the massage may be assisted by douching or spraying with hot and cold water alternately.

In the treatment of gonorrheal rheumatism, it is important to begin active treatment early, for if not treated energetically at first it becomes chronic and is very difficult to cure.

It is also of essential importance to treat the gonorrhea, which has become chronic and frequently has involved the prostate and vesicles.

CHAPTER VI.

CHRONIC URETHRITIS.

Chronic urethritis is one of the most obstinate and difficult affections to cure, which the genitourinary specialist is called upon to treat, unless the treatment is based upon a knowledge of the pathological changes which have taken place in the tissues, and the character and exact location in the urethra of the lesions.

A case of gonorrhea may be called chronic when it has lasted for ten or twelve weeks.

Chronic urethritis is sometimes incorrectly called *"gleet,"* but the true definition of gleet is: *A chronic mucopurulent discharge produced in certain localized areas of the mucous membrane of the urethra which are in a state of chronic catarrhal or granular inflammation.*

The statement that every case of gleet is dependent upon a stricture is an incorrect one. A gleety discharge may be occasioned by superficial changes in the mucous membrane, which never produce any narrowing of the urethra. On the other hand, in cases where stricture does exist, the mucous membrane lying above is never healthy, and a gleety discharge is always present.

The **predisposing causes** of the chronic urethritis may be summed up as follows: Anything which tends to prolong or prevent the natural healing of a gonorrhea, such as: (*a*) Careless ways of living on the part of the patient. (*b*) Injections which are too strong or used too frequently. (*c*) Use of alcohol or beer. (*d*) Sexual intercourse or erotic excitement.

At other times, cases which are properly treated and which have had good care become chronic, usually on account of some diathetic taint, either tuberculosis, rheumatism, gout, or sometimes incipient pulmonary phthisis.

It is convenient to study chronic inflammation of the *anterior* urethra by itself, although the posterior urethra is apt to be affected as well, at the same time.

CHRONIC ANTERIOR URETHRITIS.

PATHOLOGY.

As a result of gonorrhea, particularly in its later stages, an *infiltration of small round cells* takes place. This infiltration is the most important characteristic of the disease, and most of the other changes in the tissues

result from it. The small round cells originate partly from the capillary vessels of the mucosa and partly from a proliferation of the fixed connective-tissue cells.

The small round-celled infiltration begins in the submucous connective tissue and surrounds the lumen of the urethra completely.

Its favorite points of location are most frequently around the bulbous urethra, and next in frequency at the fossa navicularis. These are the widest and most dilatable portions of the canal, and in acute gonorrhea

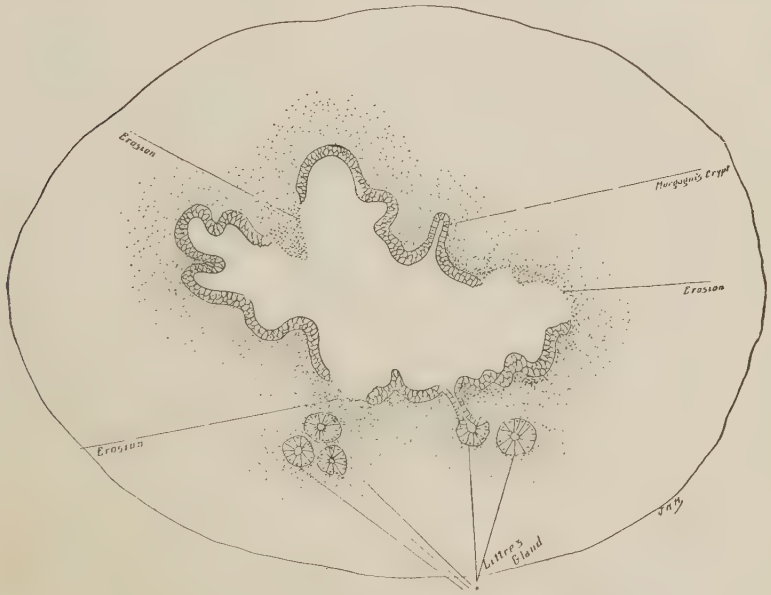

Fig. 36.—Diagram of a cross-section of the urethra, representing the histological changes in chronic urethritis.

the stream of urine is not sufficient to wash out the pus, which stagnates here and acts as a focus for the renewed local infection of the tissues at these points.

The mucous glands and follicles (Littré's glands and Morgagni's crypts), which dip down into the meshes of the corpus spongiosum, are also surrounded by and imbedded in the infiltration.

Clinically we may classify the cases of chronic urethritis according to the extent of the infiltration into: (*a*) *superficial*, or *mucous, form*, in which the small round-celled infiltration is confined to the mucous membrane, subepithelial connective tissue and periglandular tissue alone, and which is not followed by stricture, and (*b*) the *deep form* of infiltration.

In the latter class the infiltration extends *deeply* into the tissues, and involves the meshes of the corpus spongiosum extensively and is always followed by stricture.

Glandular Changes.—During the course of the gonorrhea the gonococci penetrate into *Morgagni's crypts* and *Littré's glands* and set up an inflammation in the cavities, which is accompanied by an infiltration of small round cells *around* the ducts and walls of the glands (periglandular infiltration).

The infiltration around the duct stiffens it and keeps its mouth open and gaping, affording an open gateway for the escape of the inflammatory products which have formed within the cavity of the gland.

The gonococci may continue to propagate within the cavities of the glands for months after the inflammation has entirely ceased on the free surface of the mucous membrane.

The reappearance of an acute purulent discharge containing gonococci, a so-called *relapse,* is due to an escape of gonococci from the glands and a reinfection of the surface of the mucous membrane.

Infection of wives and mistresses with gonorrhea, during coitus, is often caused in the same way, viz.: the escape of pus-cells containing gonococci, which had been formed by the suppurative process continuing in the gland-cavities after the surface of the mucous membrane had been well for months. During intercourse the pus, mixed with seminal fluid, is deposited in the vagina of the female and infection follows.

The inflammatory products, consisting of desquamated epithelial cells, pus-cells, and granular material, which stuff the cavities of the glands, are washed out by the act of urination and appear floating about in the urine as shreds.

The small granules are probably formed in the glands of the anterior urethra, and the larger plugs, shaped like a comma or tadpole (Fürbringer's hooks), originate in the follicles of the prostatic urethra.

Larger "clap-shreds" are also always present, and are occasioned by the secretion from erosions drying upon the surface, forming a scab, which is washed away by the stream of urine.

Changes in the Mucosa.—During the acute inflammatory stage of a gonorrhea the cylindrical epithelium lining the urethra is loosened and thrown off in patches, leaving superficial *erosions.* These losses of epithelium, except in very rare instances, are not deep enough to deserve the name of ulcers.

On account of the round-celled infiltration of the submucous tissues the erosions do not heal readily, but remain uncovered by epithelium for a long time.

The blood-vessels in the submucous tissues send up newly formed capillary loops, which traverse the infiltration in an upward direction, and as they grow toward the surface penetrate the floor of the erosion and convert it into a bed of newly formed *granulations.*

These "granular patches" resemble an ulcer in any part of the body after it has become covered with luxuriant florid granulations, which are composed purely of capillary loops, having no tendency to cicatrize and which are easily broken down and destroyed by slight force.

In other cases the mucous membrane is not eroded and there are no

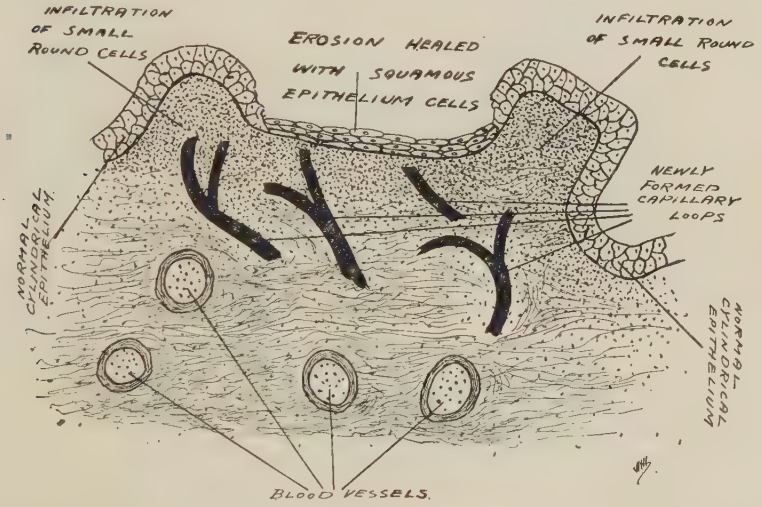
INFILTRATION OF SMALL ROUND CELLS
EROSION HEALED WITH SQUAMOUS EPITHELIUM CELLS
INFILTRATION OF SMALL ROUND CELLS
NEWLY FORMED CAPILLARY LOOPS
NORMAL CYLINDRICAL EPITHELIUM
BLOOD VESSELS

Fig. 37.—Diagram of a section of the urethra, representing the histological changes in the formation of a granular patch in chronic urethritis.

granular patches present: Instead of a loss of substance there is simply swelling, congestion, and edema of the mucous membrane, in scattered patches, occasioned by its being in a condition of chronic inflammation and infiltration with leucocytes.

These superficial changes in the mucous membrane occasion a continuous gleety discharge until they are healed.

Final healing of the lesions is brought about as follows:—

When the small round-celled infiltration is first deposited, it is soft and succulent, and while in this state it may disappear, entirely or in part, by a process of *absorption.*

If absorption does not take place, the small, round, infiltrating cells become organized, and are replaced by true fibrous connective tissues of a low grade, which goes on to *contraction.*

In a case where the infiltration was of the *superficial,* or *mucous, form,* involving only the mucous membrane and surrounding the glands, stricture does not follow.

In the *deep* form of infiltration, however, which extends deeply into the periurethral tissues and involves the meshes of the corpus spongiosum extensively, the heavy masses of scar-tissue, into which the infiltration becomes converted, contract, impair the dilatability or may materially decrease the caliber of the urethral canal, and form *stricture.*

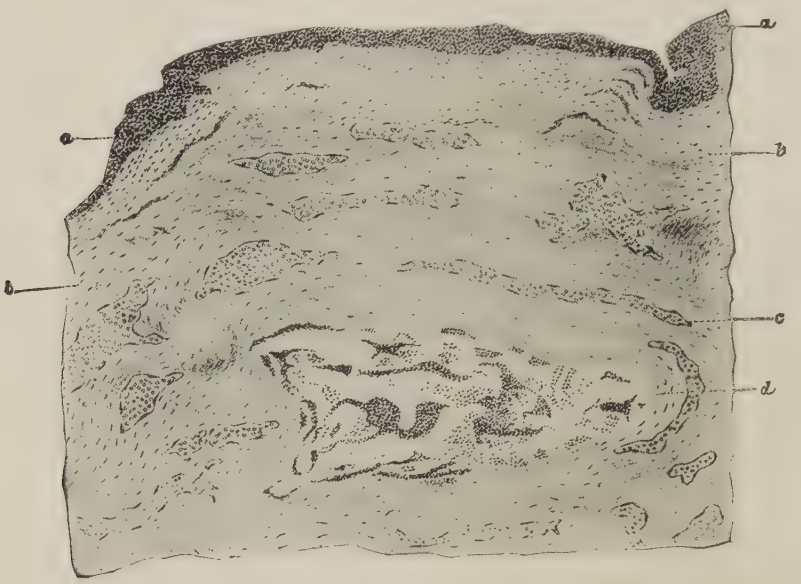

Fig. 38.—Beginning stricture. *a,* squamous epithelium in many layers; *b,* contracted connective tissue; *c,* contracted meshes of the corpus spongiosum; *d,* remains of Littré's gland, obliterated through contraction of the periglandular and interstitial connective tissue. (From "Die Syphilis und die Venerischen Krankheiten," von *Dr. Ernest Finger.*)

After the infiltration which surrounded Morgagni's crypts and Littré's glands has been converted into scar-tissue, its subsequent contraction squeezes the walls together; so that the glands are compressed and obliterated.

The granulations, which have formed upon the erosions, consist simply of capillary blood-vessels, which have been given off from the submucous vessels and have penetrated the infiltration in an upward direction. After the formation of scar-tissue its contraction squeezes the capillaries together and destroys them, and the granulations disappear as a result of strangulation.

The erosions become covered not with the normal cylindrical epithelium of the healthy portions of the mucous membrane, but by many layers of squamous epithelium.

The changes wrought by the conversion and contraction of the scar-tissue require from two to ten years for their completion, and they do not proceed with a uniform degree of rapidity; so that, on examining a case, all gradations of the process may often be seen at the same time.

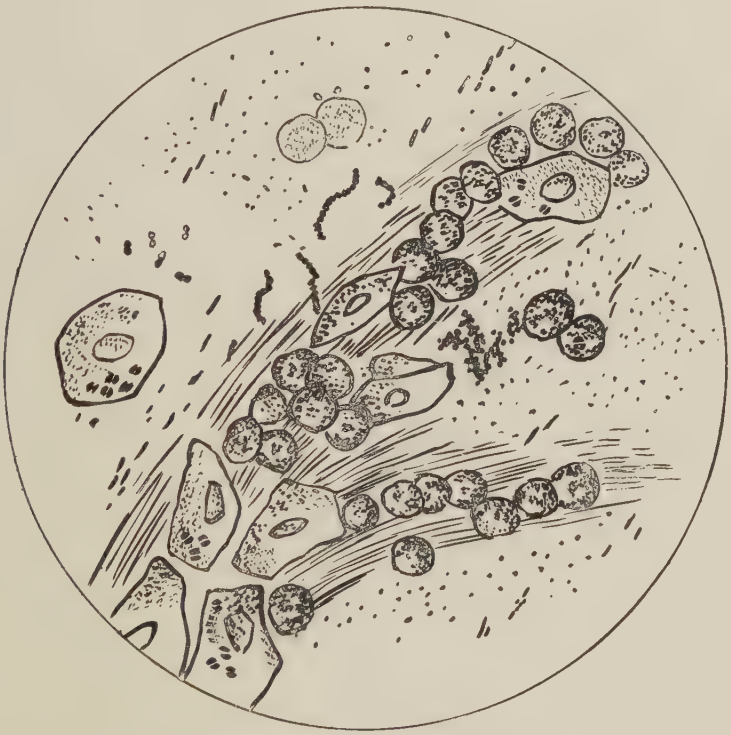

Fig. 39.—Shred from a case of gonorrhea of long standing. Mixed infection has occurred. The specimen shows desquamated squamous epithelial cells, with gonococci on their surfaces, pus-cells, staphylococci, and streptococci arranged in chains.

SYMPTOMS.

There is an absence of any marked subjective symptoms; there may be at most an occasional tickling at the meatus.

The *discharge* from the urethra is mucopurulent, thin, and scanty, and is often so slight that there is only a drop in the morning or a sticking together of the lips of the meatus.

A common feature of chronic urethritis is the *exacerbations,* which are constantly occurring. The patient develops a profuse purulent discharge, which is checked very promptly by treatment.

As a result of various indiscretions, an acute inflammation is set up in the damaged portions of the urethra, and the discharge which is produced in them occasions a *reinfection* of healthy portions of the canal, as it passes over them.

When a considerable extent of surface of the mucous membrane is involved in the inflammatory process, if the patient passes his water into two glasses, the first glass is *turbid* from the quantity of pus washed out from the canal. On microscopic examination the discharge is found to be composed of pus-cells, containing gonococci in profusion, desquamated epithelial cells, and mucus from crypts and follicles. After the inflammation is *localized,* and exists only in spots, the urine in the first glass is no longer turbid, but shows a few shreds floating in *clear* urine.

The presence of *shreds* always indicates that at some point along the urethra the mucous membrane is diseased, and a shred is simply the secretion, which forms a scab on the surface, and is washed off by the stream of urine. The form of lesion may be an erosion or granular patch or a chronic catarrh of the mucous membrane lying over an infiltration.

Microscopic examination shows the *composition* of shreds to be pus-cells, which may or may not contain gonococci, and desquamated epithelium, held together by a quantity of mucus.

In *shape* shreds present themselves as heavy flakes; long, slender filaments; tadpole-shaped bodies, or small granules. The heavy shreds always contain pus, and sink to the bottom, while the light filaments are composed entirely of squamous epithelial cells and float. The point of practical clinical importance to determine is whether the shreds are made up of pus-cells containing gonococci, or whether they are composed of squamous epithelium alone, desquamated from the healed surface of a former lesion.

DIAGNOSIS.

The points to determine in making the diagnosis of the conditions in chronic anterior urethritis are:—

(*a*) Whether a considerable surface of the urethral mucous membrane is involved in the inflammatory process, and secreting pus freely. When this is the case it is indicated by a *turbid,* cloudy appearance of the first glass of urine, on making the two-glass test. Or

(*b*) Whether the inflammation is no longer general, but limited to *localized areas.* In the latter condition the first glass of urine will contain *shreds* floating in *clear* urine.

It is equally important to ascertain if:—

(*c*) The inflammatory process is *superficial;* that is, limited to the mucous membrane and glands; or if:—

(*d*) The infiltration has involved the meshes of the corpus spongiosum, and commencing stricture is present. The instruments useful in settling points *c* and *d* are: (1) the Otis urethrometer, (2) the bulbous bougie, and (3) the endoscope.

Otis Urethrometer.—*Method of Using.*—The point of *greatest dilatability* of the normal urethra is at the bulb, and on withdrawing the urethrometer we find that the dilatability of the urethra is diminished *gradually* toward the meatus, except at the fossa navicularis. When a *deep* infiltration is present the dilatability of the urethra is diminished *abruptly,* but the urethral canal is freely dilatable both *before* and *behind* the infiltrated point.

On the other hand, *superficial* infiltrations involving only the mucous

Fig. 40.—Otis urethrometer.

membrane do not extend into the deeper submucous tissues or meshes of corpus spongiosum and do not interfere with the dilatability of the urethral canal.

It is important to recognize deep infiltrations, while they are still soft and recent and before they have been converted with scar-tissue, so as to bring about their *absorption* and prevent the formation of stricture.

The bulbous bougie, preferably the flexible variety, may be used for the same purpose, but is better adapted to recognizing infiltrations which have been transformed into scar-tissue and begun to contract.

The use of the microscope is as important in chronic urethritis as in the acute variety, for without its use the presence or absence of gonococci cannot be determined.

In the cases, which are very frequent, where a mixed infection with other organisms has occurred, it is impossible to recognize them without the microscope.

It is also necessary in differentiating other urethral discharges from gonorrhea.

Fürbringer has described under the term *urethrorrhœa ex libidine* a discharge which occurs from the meatus in strong healthy individuals after prolonged erection without coitus and consisting of a white, glairy fluid.

Under the microscope this is found to be composed of scanty epithelial cells, a few scattered leucocytes, and mucus.

Prostatorrhea and spermatorrhea present such characteristic pictures under the microscope as to be easily differentiated.

To complete the examination of a case of chronic gonorrhea a

Fig. 41

Fig. 42

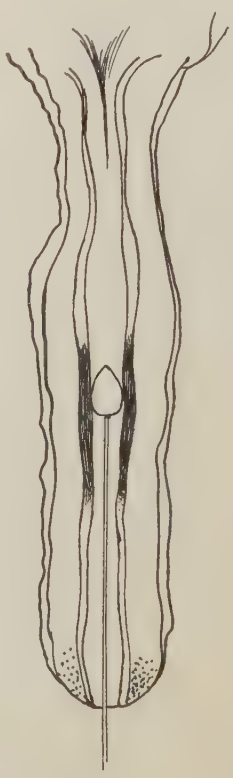

Fig. 41.—Diagram showing method of detecting deep infiltration in chronic urethritis, with bougie à boule or urethrometer.

Fig. 42.—Diagram showing impossibility of recognizing superficial infiltration, involving mucous membrane alone, by means of bougie à boule or urethrometer.

urethroscopic examination should also be made, but to be of any value the surgeon attempting it should have had enough experience to recognize the conditions, and to learn to do this requires months of constant practice.

In many cases sufficient information for the appropriate treatment can be elicited by inspecting the urine, examining the discharge from the

meatus with the microscope, and exploring the urethra with a bulbous bougie, but the cases of infection of Morgagni's crypts (glandular urethritis) can only be recognized and treated with the endoscope. The progressive healing and change in character of the epithelium under the treatment by dilatation cannot be observed in any other way than by urethroscopic examination, and certain rare conditions, such as polypi or urethral granulations, cannot be diagnosed, except by the use of this instrument.

In all cases, then, where the conditions do not seem to improve under treatment, a urethroscopic examination by a capable urologist should be made to revise the diagnosis.

TREATMENT OF CHRONIC ANTERIOR URETHRITIS.

To understand clearly the indications for treatment it may be desirable to recapitulate the forms which chronic urethritis assumes, using Finger's classification.

Forms of Chronic Urethritis.

I. *Recent cases,* in which an extensive surface is involved in a general catarrh.

II. *Cases of long standing which are more chronic,* in which, instead of a general inflammation, the process is localized in isolated spots. The disease may be

(*a*) *Superficial* and confined to the mucous membrane, or

(*b*) *Deep* and in the submucous connective tissue, often complicated by

(*c*) Affections of the paraurethral glands.

In the cases of chronic urethritis of the **superficial variety**—that is, when the diseased condition is limited to the mucous membrane, and does not affect the deeper tissues—*the indications for treatment* are (*a*) to rid the tissues of gonococci; (*b*) to cure the catarrhal inflammation so that only the deep foci remain; (*c*) to promote the formation of squamous epithelium to cover the erosions.

These indications are fulfilled by the local application of astringent and antiseptic solutions. When **general catarrh** of the mucous membrane is present, as indicated by turbidity of the first glass of urine, the patient may inject his urethra with an ordinary gonorrhea syringe, and gradually increase the strength of the injections. (For formulæ see "Acute Gonorrhea.") It is preferable, however, to use an *irrigator,* which has the advantage of distending the folds of mucous membrane and insuring a thorough contact of the solution with its entire surface.

A soft-rubber catheter, attached to a large-sized hard-rubber syringe holding 4 ounces, carried down into the bulbous urethra, may be used, but it is not as effective as the irrigator. (See Janet Irrigation.)

As long as microscopic examination shows the presence of gonococci, the best solution to use for irrigation is albargin, 1 : 1000. Under irrigations every day or every second day the pus disappears and the urine becomes clear, with a few shreds floating in it, and the gonococci are no longer to be found with the microscope.

Nitrate-of-silver irrigations, 1 : 10,000 to 1 : 4000, may be substituted for the albargin at this point. The appearance of a marked reaction with free suppuration and gonococci after the nitrate of silver denotes that a focus of gonococci had been opened up and a reinfection of the tissues caused.

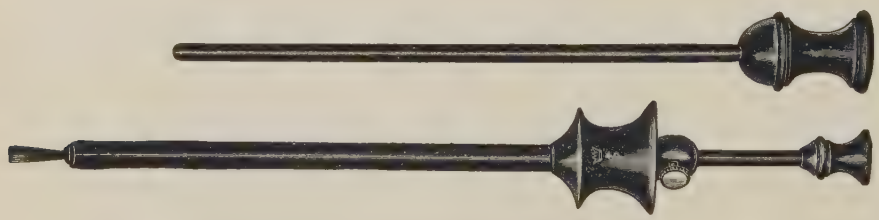

Fig. 43.—Ultzmann's brush apparatus. (Kny-Scherer Company.)

If no reaction follows, the nitrate-of-silver irrigations may be continued, until no further improvement is noticed and the case is at a standstill.

The process at this time has ceased to be general and is confined to isolated spots, and on examining the urine it is found no longer to be turbid from admixture with pus, but *clear and with numerous shreds* floating in it. The presence of clear urine containing shreds is regarded as an indication for substituting stronger applications to the diseased spots than can be used by irrigation.

The best means of applying strong astringents to the isolated foci are by means of (*a*) the Ultzmann brush apparatus, and (*b*) instillations with an Ultzmann or Guyon syringe.

The Ultzmann Brush Apparatus.—This instrument is particularly adapted to the treatment of old foci of inflammation which are located in the bulbous dilatation of the urethra, accompanied perhaps by a few scattered areas along the anterior urethra.

If the instrument is introduced and the entire anterior urethra is brushed over, by a combined rotary and withdrawing motion of the brush, with a solution of nitrate of silver from 15 to 25 grains to the ounce in strength, and examined immediately afterward with the endo-

scope, the diseased spots will be seen to be colored a whitish gray, while the healthy portions of mucous membrane will appear unaltered by the nitrate of silver. In this way the growth of epithelium is stimulated over the eroded spots.

Particular attention should be given to the bulb, brushing it out first with water to remove the adherent secretion, subsequently *twice* with the medicament. Instead of nitrate of silver, Frank advises using a solution of lactate of copper, 2 per cent., in glycerin, applied every second day.

Instillations.—By means of Guyon's or Ultzmann's syringe concentrated solutions of nitrate of silver can be deposited, drop by drop, along the whole length of the urethra, from the vesical sphincter to the meatus, thus bringing the medicament in contact with healthy and diseased portions alike.

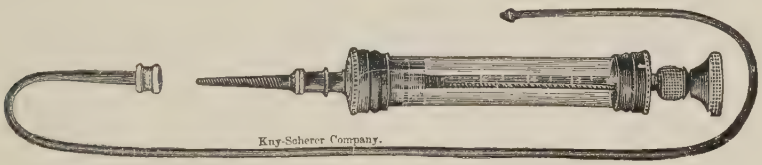

Fig. 44.—Guyon's syringe.

The patient may be allowed to use a mild astringent injection, upon the days when no instillation is made.

During the course of the treatment *exacerbations,* accompanied by vesical tenesmus, free suppuration, and turbidity of both glasses of urine, occur at times. When these happen, the instillations must, of course, be suspended and either sandal-wood oil or salicylate of soda given by the mouth, or, if the exacerbation is not very severe, the case may be treated by irrigations until the urine is again free from pus, when the instillations may be resumed.

It is very exceptional for the diseased foci to be so isolated that they can be treated in any other way, even through the endoscope.

The indication for the use of instillations of nitrate of silver is considered to be the *presence of clap shreds floating in clear urine.*

In a case coming under treatment, however, for the first time, instillations should never be used until the effect of irrigations has been tried, for the treatment of chronic gonorrhea is founded upon the principle of beginning with mild applications and gradually proceeding to the use of stronger and more irritating measures.

Another point to bear in mind is the fact that the irritation caused by the application of concentrated and caustic solutions may in itself prolong the inflammation and prevent the recovery. So that it is always

desirable, in a case which has been energetically treated, to interrupt, for two or three weeks, all local applications, in order to allow the irritation caused by them to subside.

In beginning the treatment with instillations, 15 drops of a 2-grain-to-the-ounce solution of nitrate of silver should be used, which cause some reaction, burning on urination, and increased secretion, which lasts for twenty-four hours and then subsides.

In every case where the presence of posterior urethritis is suspected, the point of the syringe should be carried beyond the cut-off muscle and a few drops of the solution deposited along the posterior urethra; and as the syringe is withdrawn the anterior urethra is "etched," a drop at a time, along its entire length.

The instillations should be made every two days and used two, three, or four times, or, in fact, as long as a diminution in the shreds is noted. By this time the urethra has become accustomed to the irritation of the solution, and its strength must be increased to 5 grains to the ounce. The strength of the solutions is gradually increased in this way until the patient is well or until a strength of 25 grains to the ounce is attained.

Various other means have been suggested for applying astringents to diseased spots in the mucous membrane, such as gelatin or cocoa-butter suppositories, medicated ointments, and direct applications through the urethroscope.

None of these methods has proven satisfactory, and, while applications through the urethroscope to the posterior urethra are indispensable in certain cases of swelling of the colliculus, the only use for the urethroscope in the anterior urethra is as an instrument for diagnosis or to permit the removal of polypi or the destruction of chronically inflamed Morgagni's crypts.

The use of *astringent injections* may be continued by the patient himself during this time as an adjuvant to irrigations and stronger applications.

Care should always be taken, however, not to use the injections often enough to add to the irritation resulting from the other applications.

In treating patients with chronic urethritis it should always be borne in mind that in nearly every case a submucous infiltration of small round cells is present in the deeper tissues, often complicated by disease of the paraurethral glands, and it is impossible to cure the lesions on the surface as long as the deep or submucous infiltrate exists.

The deep form of chronic urethritis must be treated on entirely different lines from the superficial variety.

In these cases the infiltration lying underneath the mucous membrane cannot be reached by applying astringent or bactericidal solutions to its surface, and, while the secretion may be held temporarily in check, an exacerbation occurs on the slightest provocation.

The indications for treatment are:—

I. To promote the absorption of the infiltration and restore the elasticity of the urethral wall.

II. To subdue the existing superficial inflammation in the mucous membrane and glands.

III. To destroy the gonococci, which are harbored in the substance of the infiltration and in the urethral glands.

The first indication—that is, the promotion of the absorption of the infiltration—is met by the passage of a **steel sound** large enough to distend the urethra fully and put the ring of infiltration upon the stretch.

The therapeutic effects of the passage of sounds are:—

Fig. 45.—Steel sound with van Buren curve.

I. To allay urethral hyperesthesia. The passage of the sound blunts the extreme sensitiveness of the nerve-filaments and abolishes any spasmodic contractions of the muscular fibers which may be present.

II. The infiltration lying beneath the mucous membrane renders it rigid and impairs its elasticity. A sound large enough to distend the urethra stretches the infiltration and causes small tears in its substance beneath the mucous membrane. A traumatic inflammation, with increased vascularization, results from these tears, and absorption is stimulated.

III. The passage of a sound expresses and squeezes out the contents of the suppurating urethral crypts and follicles.

IV. The stretching of the urethral walls by the sound breaks down granulations and stimulates the formation of epithelium upon eroded spots.

In order to meet these conditions it is necessary to use a sound of *large* caliber, which will fully distend and stretch the urethral canal.

The therapeutic effects of the sound can be materially increased by massaging the urethra over it with the fingers. The contents of Morgagni's crypts can in this way be expressed, and a favorable influence is exerted upon the ring of infiltration in the submucous tissues.

The sound should not be passed too frequently. In cases of soft and recent infiltration the intervals may be from two to four days, always waiting until the reaction following has subsided. In cases of hard, organized infiltration the intervals should be longer: from five to eight days.

If the *meatus* is too narrow to admit a sound of sufficient size, it should be divided upon the floor.

There are, however, certain cases where it is undesirable to enlarge the meatus, as, for instance, in hypospadias, and, again, there are other cases where the urethra is so capacious that a No. 30 French sound will lie in it loosely without stretching the walls or compressing the infiltration. In these cases recourse may be had to the **Oberlaender or Kollmann dilator**, and by preference the new model of irrigating dilator by which irrigation of the urethra is carried on simultaneously with the dilatation.

The action of a dilator is to tear apart the infiltration underneath the mucous membrane, which remains intact without being wounded.

This is an important feature of dilatation, since any fresh wound of the mucous membrane would open up a passage for revived infection with micro-organisms.

Oberlaender claims that a fresh inflammation starts up from the tears in the infiltration, and the increased vascularization occurs in its absorption.

The dilatation also causes an exfoliation of epithelium in other parts of the urethra.

The effect of dilatation is also very marked on the mouths of Morgagni's crypts. The mouths of the crypts may be kept open and gaping by a stiffened ring of periglandular infiltration.

Free dilatation puts them on the stretch, forces out their stagnating contents, and causes the absorption of the infiltration. If, on the other hand, the mouths of the crypts are closed by a hyperplasia of epithelium over them, dilatation opens them and permits the escape of the retained secretion.

The Frank or Kollmann dilators with the irrigating attachment are to be preferred to Kollmann's simple dilator, as these instruments are provided with three and four blades, and the pressure is brought on several sides of the urethral wall, lessening the danger of laceration.

It is also of great advantage to irrigate the urethra when it is fully dilated, for at this time the mouths of Morgagni's crypts are open and the irrigating fluid enters them, besides coming in thorough contact with the walls of the urethra, when its folds are smoothed out.

It should always be borne in mind in using these dilators that the dilatation must be made very gently, for with the powerful leverage of the instrument extensive lacerations may easily occur unless great care is used.

A laceration is a serious accident. The hemorrhage may be alarming in its extent and urinary fever is very apt to follow.

If inflammation and secretion are present in chronic gonorrhea, dilatation may be begun at 26 or 28 at the first sitting, and increased at the other sittings.

In a week another dilatation may be made and the dilatations in the course of some weeks carried up to 35 or 36, increasing one or two numbers at each sitting. After 36 is reached the dilatation must be done more cautiously, ascending from one-half to one number at a sitting.

Improvement is generally noted about 35, when the shreds begin to grow lighter.

The dilatation may be carried up to 45, but it is seldom necessary.

When the infiltration is confined to the anterior urethra alone, the anterior dilator is of course required; but when the disease has affected the membranous and prostatic portions of the urethra the posterior dilator must be used.

The dilator may be used even though a few gonococci are present, but it is always better to rid the urethra of gonococci as much as possible by an active course of treatment before commencing the treatment with the dilator.

If the urethra is acutely inflamed and secreting pus freely, instrumentation is, of course, out of the question, and the dilatations should not be begun until the urine is clear and contains only shreds.

With regard to the appropriate solutions for irrigating the urethra, albargin, 1 : 1000, should be used as long as gonococci are present. After they have disappeared, nitrate of silver, 1 : 10,000 to 1 : 4000, is in order. Oxycyanide of mercury, 1 : 4000, is the best solution when no gonococci, but other micro-organisms, are present in numbers.

In the intervals between the dilating irrigations the patient should have urethral irrigations made every other day by the surgeon (see Janet irrigation), and should use a hand injection of one of the astringent salts himself.

It makes no difference, as far as treatment is concerned, whether the submucoid round-celled infiltration is soft and recent or whether it has been transformed into scar-tissue. The indications in either case are, by dilatation and pressure to promote its absorption. Cases in which a considerable surface of mucous membrane is involved are

unsuitable for dilatation, until the catarrh has been checked by irrigations and the superficial process is localized in a few spots in the urethra, as denoted by shreds floating in clear urine.

The second and third indications—which are to cure the inflammation in the mucous membrane and glands and destroy the gonococci —have already been considered under the treatment of the superficial form of urethritis, and the measures adapted to these ends should be combined with the dilatation.

If a steel sound or simple dilator without the irrigating attachment is used, it is always necessary to use a copious irrigation of the urethra afterward.

The folds of the mucous membrane are smoothed out by the pressure of the sound, and the solution comes in contact with the whole surface. If small tears have occurred in the mucous membrane from stretching, the irrigating fluid seals them up and prevents infection.

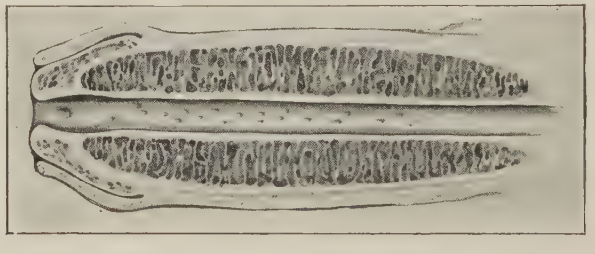

Fig. 46.—Roof of urethra, showing openings of Morgagni's crypts and lacuna magna.

GLANDULAR URETHRITIS.

Many intractable cases of gonorrhea lasting for years in spite of constant treatment are caused by a chronic inflammation of **Morgagni's crypts.**

Such cases show but few symptoms, merely a morning drop or moisture at the meatus, but are characterized by exacerbations of the discharge after slight provocation, with a free flow of pus containing gonococci, and leading the patient to believe that he has acquired a fresh infection.

Urethroscopic examination shows the mouths of a few of the crypts to be open and pouting, with the edges red and slightly elevated above the surface. In other cases the mouths of the crypts are occluded by a growth of epithelial cells.

When the crypts are affected the gonococci remain in them for years and retain their infectious properties.

The treatment of these cases may be begun by dilatations with the Kollmann irrigating dilator.

When the mouths of the glands are occluded by the growth of epithelial cells over them, dilatation of the urethra opens up their mouths and forces out the purulent secretion contained within them.

The accompanying irrigation enters their cavities and acts upon the chronic inflammatory process within the glands.

In the second form of affection of the glands, where their mouths are held open and the entire crypt is stiffened and inelastic from the periglandular infiltration, dilatations cause the absorption of the infiltrate around the glands and a return to the normal conditions.

When after sufficient treatment with dilatation and irrigations, it is found by urethroscopic examinations that a few glands still remain

Fig. 47.—Galvanocaustic needle and handle.

chronically inflamed and suppurating, acting as foci of infection, they should be treated as any other suppurating sinus and destroyed. This can be accomplished by bringing them into view with the urethroscope, introducing a galvanocaustic needle into them, and destroying them by the cautery. The cauterization must be very superficial and rapid; otherwise, there is danger of stricture formation.

To avoid the danger of stricture from too much burning, Levin uses an electrolysis needle, which is superficial in its action, but effective.

Three or four crypts may be destroyed at a sitting, and it is possible sometimes, by disposing of the glands harboring the gonococci, to cure a chronic gonorrhea of years' standing which had resisted all the usual forms of treatment.

In all cases of chronic urethritis the condition of the prostate and seminal vesicles should always receive attention, for in the large proportion of individuals so affected the *prostate* and *seminal vesicles* will be found diseased and will require appropriate treatment. (See Prostate and Seminal Vesicles.)

CHRONIC POSTERIOR URETHRITIS.

The posterior urethra is involved in about 80 per cent. of all cases of acute gonorrhea. In many of these the disease never becomes chronic, but, when it does, the posterior urethra remains inflamed quite as often as the anterior.

Chronic posterior urethritis may exist alone, the inflammation having run its course and ended in the anterior part of the canal, but we frequently find a chronic inflammation of both anterior and posterior portions of the urethra at the same time.

Acute posterior urethritis is almost invariably caused by gonorrhea, but a *chronic* inflammation can be occasioned in other ways. Any cause which tends to produce a prolonged state of *congestion* in the posterior urethra which is oft repeated will, in time, lead to the establishment of a condition of *inflammation* in the mucous membrane and hyperplasia of the submucous tissues.

The causes which are usually responsible for these conditions are excessive sexual intercourse or sexual abuses, such as masturbation or coitus reservatus (withdrawal).

The habit of withdrawing the penis during the act of coitus and allowing the seminal fluid to be ejaculated outside the vagina, for the purpose of preventing conception, has a most pernicious effect upon the mucous membrane of the posterior urethra. It induces a chronic congestion with involvement of the colliculus, and is always followed sooner or later by an attendant train of nervous symptoms, which are known under the general term of *sexual neurasthenia.*

The habit of masturbation acts in precisely the same way, and the men who practise it present the same group of symptoms.

Another cause which occasionally operates in inducing chronic posterior urethritis is horseback riding upon a saddle which is improperly made so that the middle ridge presses upon the posterior urethra. The prolonged intermittent pressure upon the colliculus sets up at first a congestion and finally a true colliculitis.

For all practical purposes, the symptoms and treatment of chronic posterior urethritis may be considered together, without regard to its etiology.

PATHOLOGY.

On account of the abundant supply of glands and follicles and the thickness and vascularity of the mucous membrane the pus formation is apt to linger in the posterior urethra for years, and is very apt to attack the prostate and seminal vesicles.

The histological changes are substantially the same as in chronic anterior urethritis.

The mucous membrane is in a state of chronic inflammation, with desquamation of its epithelium, and the submucous tissues are the seat of a small round-celled infiltration, which also surrounds the mucous crypts. The infiltration, in time, becomes converted into scar-tissue and the glands are obliterated by its pressure. The infiltration, however, is not transformed into distinct *bands* of scar-tissue, such as form strictures in the anterior urethra, but there is simply a *general condensation* or *fibrous hardening* of the periurethral tissues.

The sclerosis of the submucous tissue does not materially narrow the caliber of the urethra, and, consequently, stricture never occurs in the posterior urethra, except from traumatic origin.

The *verumontanum,* or *colliculus seminalis,* is always affected in chronic posterior urethritis. It is enlarged, the mucous membrane is bluish in color and softened, and the natural sensitiveness is aggravated to a high degree. This structure is the point most highly supplied with nervous filaments in the urethra, and, on account of its increased receptive influence to painful impressions, when the submucous infiltration begins to contract it compresses these nerves and occasions marked reflex disturbances.

The symptoms are often *mental,* and take the form of hypochondria, depression, irritability, and inability for sustained mental effort, or may be *neuralgic* in character and referred to distant or associated organs.

DIAGNOSIS.

The two-glass urine test is only applicable to cases where there is a considerable amount of pus formation, in which both first and second glasses are turbid and often contain small shreds shaped like a comma or tadpole.

These are known as *Fürbringer's hooks* and are plugs of secretion which have been formed within the mouths of the prostatic ducts.

When present they denote that the general inflammation of the posterior urethra has extended by continuing into the prostatic ducts.

In the following instances the posterior urethra may be chronically inflamed and the second glass of urine will not be discolored:—

(*a*) When such a *small quantity* of pus is secreted that it does not flow back and discolor the urine in the bladder.

(*b*) When the stream of urine is feeble in force and not sufficient to wash out the mucous plugs from the crypts and follicles in the mucous membrane and the mouths of the prostatic ducts, contraction

of the muscular structures surrounding the urethra is necessary to accomplish their emptying.

(*c*) The prostate gland and seminal vesicles may be chronically inflamed and yet the pus formed does not flow out freely enough to appear in the urine *unless* direct pressure is made upon those organs by means of the finger in the rectum.

The **Jadassohn-Van Zeissl method** is useful in overcoming objections *a* and *b*. The *technique* is as follows:—

The *anterior* urethra is irrigated by means of a catheter attached to a syringe or irrigator, which is carried down to the cut-off muscle. After the anterior urethra has been thoroughly cleansed the patient urinates in a glass, and the urine contains the pus or shreds washed out from the posterior urethra. The patient then passes the remainder of his urine in another glass, which represents the condition of the urine which had accumulated in the bladder.

After both anterior and posterior urethras have been cleansed of accumulated secretions by washing out and urinating, the secretions from the prostate gland and seminal vesicles should be collected by means of **Jadassohn's expression urine test.** By means of a finger in the rectum pressure or massage is exerted upon the prostate gland and the seminal vesicles, and their contents are squeezed out into the urethra. The patient then urinates and washes out the expressed secretions into a glass. The urine in the glass containing the secretions expressed from the prostate and vesicles is called the *expression urine.*

In examining cases of chronic posterior urethritis we should always pay particular attention to the condition of the *seminal vesicles* and *prostate gland.* These organs are very liable to be affected by an extension of the gonorrheal inflammation from the urethra, and when once attacked the gonococci are very likely to remain in them and continue to propagate for months and, indeed, in some cases, for years.

The **urethroscope** is always indispensable in making the diagnosis of chronic posterior urethritis, but should not be used until the disease has become very chronic.

If introduced prematurely into the posterior urethra it causes extreme pain and may aggravate the inflammation.

There is also some danger of its inducing epididymitis or vesiculitis. Without a urethroscopic examination, however, it is impossible to diagnose or successfully treat this condition, and in the chronic non-gonorrheal cases with but little secretion its use in practised hands is free from danger.

After introducing the urethroscope in a case of chronic posterior urethritis the urethra is seen to be of a purplish color and bleeds so

freely that the view is obscured until the blood is wiped away with cotton tampons.

The colliculus is swollen and enlarged, appearing like a half-ball and filling up the end of the tube and of a bright-red or bluish color.

After the stage of formation of connective tissue beneath the mucous membrane, the appearance of the colliculus is altered, and, instead of being swollen and red, it is flat, irregular, and grayish white or yellow in color.

In very chronic cases small polypi are frequently seen growing from the colliculus.

SYMPTOMS.

If the posterior urethra alone is diseased, there is an *absence* of purulent discharge from the meatus.

In the later stages of the disease there is but very slight pus formation, simply a congestion of the mucous membrane, with an infiltration and condensation of the submucous tissues. But in the early stages and in exacerbations, the pus formation may be in considerable quantity, and will be easily shown by making the two-glass urine test.

On account of the chronic inflammation, the posterior urethra is always in a state of exaggerated sensitiveness, and the necessity for **frequent urination** is nearly always present. Usually the desire to urinate is so *urgent* that the patient cannot wait, but must respond at once to the call, or the urine escapes and wets his clothing.

Sexual symptoms are nearly always prominent. The sexual appetite is disturbed. There is either no inclination for coitus and, if indulged in, a condition of general nervous depression follows, or else there may be a constant desire for sexual intercourse, which is not satisfied by indulgence.

The act of coitus is not satisfactorily performed. Ejaculation occurs prematurely on account of the irritable condition of the posterior urethra, and for the same reason *seminal emissions,* or pollutions, occur at night during sleep, more frequently than is natural, and in some cases the seminal discharges may be stained with blood, which is derived either from the congested posterior urethra or else from an inflamed condition of the interior of the seminal vesicles.

If the case is allowed to go on without treatment the symptoms of feeble erection and premature ejaculation give place to a condition of absolute lack of erection and impotence in the final state.

It is not at all improbable that many of the brutal attacks and attempts at rape upon women and female children may be due to the prolonged irritation in the posterior urethra from a chronic inflammation, causing

an erotic mental state which the aggressor finally finds himself unable to control. The same may be true of persons who are guilty of the various forms of sexual perversions, and it is possible that by suitable local treatment of the posterior urethra these individuals might be returned to the ways of ordinary decent life.

Mental symptoms are a striking feature of most cases of posterior urethritis. The patients are hypochondriacal, they suffer from depression of mind, and are low-spirited, melancholy, and despondent, and in extreme cases may have suicidal impulses. In this frame of mind they fall an easy prey to quacks and charlatans, whose advertisements guaranteeing to "restore lost manhood and relieve the evils attendant upon the errors of youth" appear in the columns of the daily papers.

Nervous symptoms are always prominent, and the patient complains of a heavy feeling or a constant burning or tickling in the perineum or region of the bladder. Sometimes a feeling of heat is observed in the posterior urethra, which is increased by urination, and ejaculation is often accompanied by a shooting pain. In consequence of the irritability of the posterior urethra a spasmodic contraction of the cut-off muscle is often present, and the urine is passed in a thin, dribbling stream, as though the urethra were occluded by an organic stricture.

The reflex pains are vague and irregular in character, often shooting toward the glans penis, testicles, or down the thighs, and are increased by any bodily movement, such as riding or walking.

Usually such patients cannot sit in a cushioned chair on account of the pressure upon the perineum.

The patient is easily tired and incapable of his usual amount of mental or physical work, and presents the clinical picture of a mild form of neurasthenia. The symptoms thus grouped together are commonly spoken of as **Sexual Neurasthenia** and disappear promptly as soon as the local conditions upon which they depend are cured, and it is really remarkable to see the rapid improvement or disappearance of all the unpleasant feelings as soon as appropriate treatment is begun.

Prostatorrhea is often complained of, especially in the cases caused by masturbation or withdrawal. The flow of a glairy mucus may come with the last drops of urine voided (micturition prostatorrhea), or it may result from straining at stool (defecation prostatorrhea). The change in the tissues of the posterior urethra consists in a submucous infiltration surrounding the prostatic ducts and keeping them open and rigid, together with a proliferation of the epithelium within the ducts. Sometimes the proliferation of the epithelium closes the mouths of the ducts, and they become converted into small cyst-like cavities.

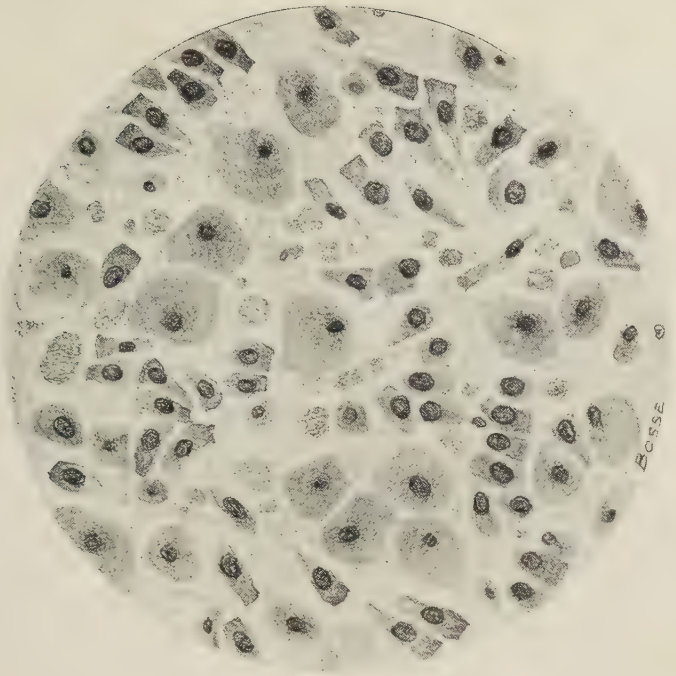

Fig. 48.—Secretion of prostatorrhea. Catarrh of prostatic ducts, containing only epithelium, cylindrical and squamous. Original drawing from microscopic specimen.

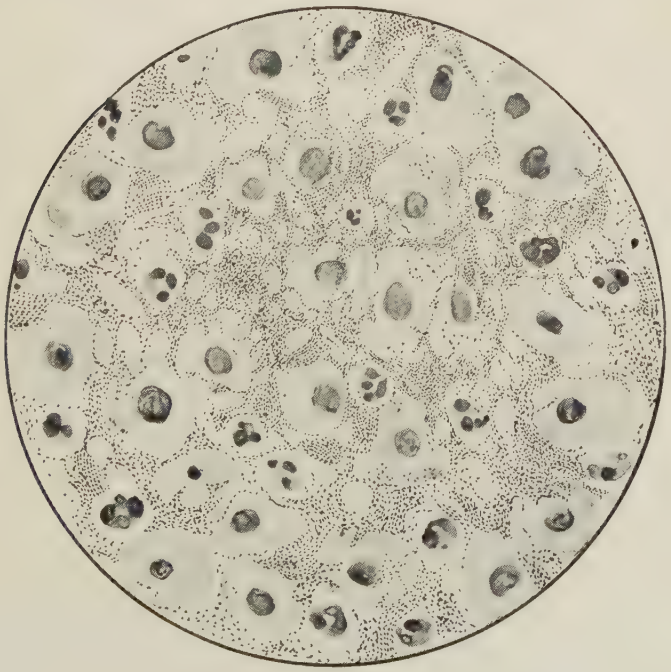

Fig. 49.—Secretion of prostatorrhea. Large numbers of bacteria, epithelial cells, and a few pus-cells. Original drawing from microscopic specimen.

If the discharge be collected upon a glass slide and examined with the microscope, two distinct varieties of the process are observed: (*a*) The discharge consists of epithelial cells from the prostatic ducts, and is caused by a pure desquamative catarrh of the acini, without suppuration. (*b*) In addition to the epithelial cells numbers of polynuclear leucocytes are found, denoting a purulent inflammation of the ducts.

Spermatorrhea is occasionally present, but not so frequent as prostatorrhea. It has been shown by Finger to be caused by a stiffening and rigidity of the ejaculatory duct from a surrounding infiltration, which causes its dilatation and closes imperfectly the outlet to the seminal vesicles, so that slight muscular pressure forces the semen to leak out.

Finger also describes a more unusual form, in which diverticula exist in the ejaculatory duct. During coitus or pollutions the semen is forced into the diverticula, where it lies until expelled by the muscular contraction during urination or defecation.

The **differential diagnosis** between prostatorrhea and spermatorrhea can only be made by collecting the discharge on a glass slide and examining it with the microscope.

Prostatorrhea is found to contain epithelial cells and lecithin bodies; pus may be present or not. Occasionally large quantities of granular phosphates are visible, and sometimes amyloid bodies can be seen.

On mixing the material with a 1 per cent. watery solution of phosphate of ammonium and letting it dry, **Böttcher's crystals** are often found. These are rhomboid in shape, and are formed by a chemical combination of the phosphate of ammonia and some material which is peculiar to the prostate and does not exist anywhere else.

The appearance of the fluid discharged in **spermatorrhea** is entirely different. It is composed of varying-sized globular masses of mucus, small quantities of granular phosphates, and numerous spermatozoa.

The presence of pus denotes a diseased condition of the seminal vesicles.

TREATMENT.

In chronic inflammation of the posterior urethra resulting from sexual excesses or abuses, the anterior urethra is not involved, and the treatment is directed to the posterior urethra alone, but in the cases caused by gonorrhea both anterior and posterior urethra are usually equally affected, and the treatment must include both parts of the canal.

For purposes of treatment it is well to divide the cases of posterior urethritis into three groups:—

(*a*) **Superficial,** in which the mucous membrane and mouths of the prostatic ducts are involved in the inflammatory process.

(*b*) **Deep form,** in which, in addition to the inflammation in the mucous membrane, there is an *infiltration* in the deeper tissues.

The small round-celled infiltration is deposited here and ultimately is converted into scar-tissue. It does not contract and form fibrous bands, but merely produces a general condensation and hardening of the submucous tissue.

(*c*) **Colliculitis, or Inflammation of the Verumontanum.**—In this condition the colliculus seminalis is the part chiefly affected, as shown by its hyperemic swelling and congestion.

In the superficial form of chronic posterior urethritis, in which the mucous membrane and prostatic acini alone are involved, where there is a considerable amount of pus formation, **irrigation** by means of an irrigator or syringe and soft-rubber catheter introduced beyond the cut-off muscle, using albargin 1 : 1000, nitrate of silver 1 : 4000, or permanganate of potash or icthargan solutions, will generally check the secretion. After the suppuration has lessened, **instillations** *with Ultzmann's syringe,* carried behind the cut-off muscle into the posterior urethra, of 15 drops of a nitrate-of-silver solution, beginning with 2 grains to the ounce and increasing as directed in the treatment of "Chronic Anterior Urethritis," usually causes a prompt disappearance of the remaining secretion and shreds. If it is desirable to medicate the posterior urethra without having the nitrate-of-silver solution come in contact with the interior of the bladder, it is well to make the instillation with the bladder full of urine. In that event any of the solution which flows back into the bladder is neutralized by the salts of the urine.

If, on the other hand, we wish to affect the base of the bladder as well as the posterior urethra, the bladder should be emptied of urine before making an instillation.

In nearly every case of posterior urethritis which becomes chronic after an acute gonorrhea, the prostate is found to be the seat of a chronic gonorrheal prostatitis; the seminal vesicles are also often affected, and it is impossible to cure the gonorrhea by treating the urethra alone; the prostate and vesicles must also receive attention at the same time. (See chapter on Prostatitis.)

Under the use of irrigations, instillations, and massage of the prostate, the inflammation in the mucous membrane is generally healed, and the *submucoid infiltration,* if present, should receive appropriate treatment.

To accomplish the absorption of the infiltration it is necessary to use **dilatations of the posterior urethra** by means of sounds or dilators.

Forcible dilatation or tearing apart of the tissues is harmful, and we should proceed with the utmost gentleness and caution in the manipulation of sounds in this region. The sound, of course, should never be passed until the free suppuration has ceased and there are only very chronic and indolent inflammatory residua remaining, on account of the danger of increasing the inflammation or of causing epididymitis.

Fig. 50.—The Guyon sound.

The **Guyon sound** is particularly adapted to the posterior urethra, on account of its shape, which is similar to that which a soft catheter assumes when it lies in the bladder and urethra. The weight of the Benique sound has some advantage, as it produces a certain amount of compression and so stimulates absorption of the infiltration, besides emptying out the crypts and follicles.

A better instrument to use, however, is the **Kollmann-Frank irrigating dilator for the posterior urethra.**

It should not be used if gonococci are present, and great care should be taken not to dilate too rapidly and so lacerate the tissues or excite epididymitis, as the tolerance to instrumentation is far less in the posterior urethra than in the anterior. During the dilatation the irrigation of the urethra should proceed with a solution of nitrate of silver, 1 : 4000. The advantage of the irrigating dilator over the simple is that at the time of full dilatation the urethral folds are smoothed out and the prostatic ducts are distended, so that the solution comes in contact with their open mouth.

In every case of chronic posterior urethritis the condition of the seminal vesicles should be investigated by rectal examination. It is useless to attempt to cure an inflamed posterior urethra when a pair of inflamed seminal vesicles are discharging a quantity of gonorrheal pus into the urethra every few days and causing an *exacerbation*. Many cases of relapsing posterior urethritis will get permanently well through a systematic stripping of the seminal vesicles, when everything else has been tried in vain.

At the same time the prostate should not be overlooked, for a follicular prostatitis is often present as a complication, and should be treated by massage through the rectum, in order to empty out the contents of the inflamed and dilated prostatic ducts.

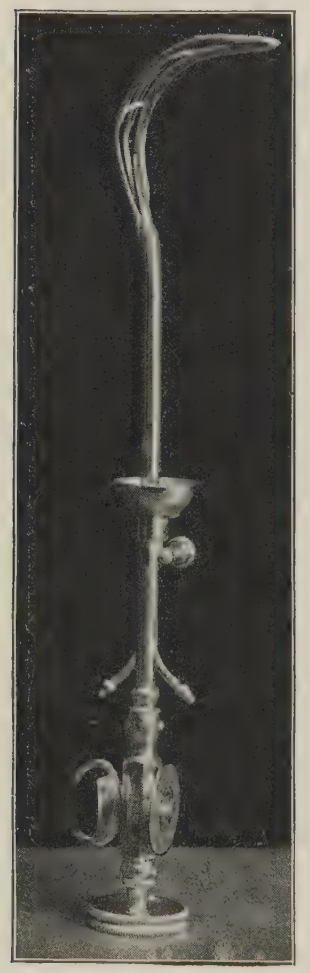

Fig. 51.—Frank's posterior dilator.

In the very chronic cases of posterior urethritis of long standing and due to sexual excesses, masturbation, or withdrawal, the measures described above are usually not sufficient to effect a cure, although a certain amount of relief is obtained.

These cases usually come under the heading of the third class, or **Colliculitis.**

There is but little or no pus formation, perhaps not even comma shreds, in the urine; submucoid infiltration may be absent, and, although the patient may present a typical clinical picture, the diagnosis cannot be made without examining the posterior with the **urethroscope.**

On introducing the endoscope the posterior urethra is found to be swollen, congested, of a deep-red or purple color, and bleeding freely, and the colliculus appears filling up the end of the tube like a half-ball, bright red or dusky in color, and exquisitely sensitive.

It is generally advisable to begin treatment by a few irrigations or instillations, and, after a fortnight's preliminary treatment, applications should be made through the urethroscope directly upon the colliculus, and care should be taken not to allow the excess of fluid to flow over the surface of the posterior urethra.

In cases where only a moderate swelling and hyperemia exist the colliculus should be painted with tincture of iodine,[1] but in the severe cases with marked enlargement the colliculus must be cauterized with nitrate of silver solution, 50 to 100 grains to the ounce.

[1] Wossidlo: Die Erkrankung des Colliculus Seminalis, Zeitschrift für Urologie, 1908, Bd. 2, Heft 3.

In very obstinate cases which do not respond to the above measures, it is necessary to burn the colliculus with the galvanocaustic point. Polypi may be twisted off with the urethral forceps or destroyed with the galvanocaustic point. After the cauterization the patient should keep quiet for two to three days, and urotropin is administered to prevent urethral fever.

The applications of nitrate of silver or cauterization should not be made oftener than once in ten to fourteen days.

In most patients so treated the reflex nervous and mental symptoms disappear, irritable impotence ceases, prostatorrhea and spermatorrhea no longer occur.

After a state of complete impotence is established, cauterization of

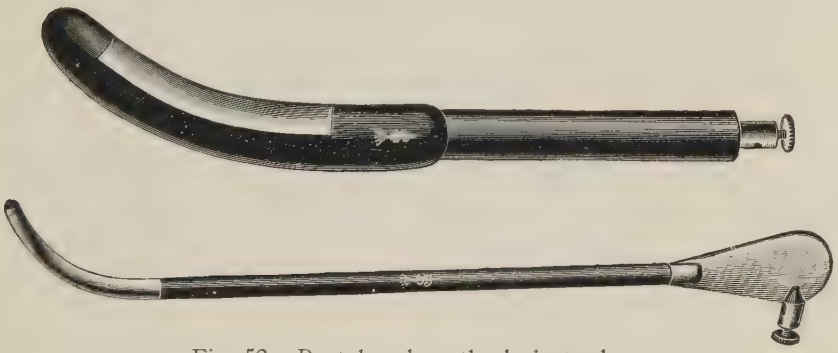

Fig. 52.—Rectal and urethral electrodes.

the colliculus is less apt to be followed by a return of the sexual power, but even these cases sometimes respond.

In all the forms of chronic posterior urethritis under the treatment described in the preceding pages the symptom-complex known as **sexual neurasthenia** rapidly clears up and generally disappears entirely, but some traces occasionally remain, even after the local changes in the posterior urethra and its adnexa have been cured.

This implies that some alteration in the functional capacity of the nerves still remains, which demands treatment with **faradic electricity.**

The galvanic current should not be used, for it causes electrolysis and acts as a caustic. Frank advises the faradic current with one pole in the rectum and the other in the urethra.

The *high note* is to be preferred, as it relaxes spasm and also has a sedative action on the nerve and obtunds its sensation.

The low note stimulates flabby muscles to powerful contraction and results in increased nutrition and better tone, but the spasm is increased. (Wappler.)

URETHROSCOPY.[1]

The changes which are disclosed upon examination with the urethroscope are not of a very striking nature, and a good deal of practice is required to detect the slight differences between normal and diseased conditions.

The urethroscope has only a diagnostic value in the anterior urethra, for the deep-lying infiltration and the glandular and periglandular changes upon which the disease of the mucous membrane depends cannot be influenced by applications made upon the surface.

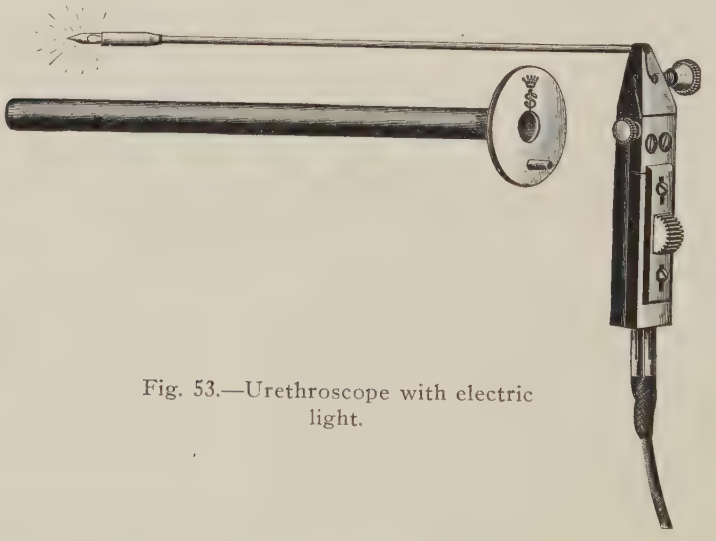

Fig. 53.—Urethroscope with electric light.

In the posterior urethra, however, the result of applications of nitrate of silver are often brilliant.

The recent invention of an electric light which gives a bright illumination without heat has resulted in a form of urethroscope with which a very satisfactory view of the urethra can be obtained.

The patient lies on a suitable table, with his feet resting on a stool. The tube with the obturator is introduced into the urethra, and when the obturator is withdrawn the electric light is inserted into the tube and carried down to its end.

As the tube is slowly withdrawn the mucous membrane rolls over its end and can be thoroughly inspected.

[1] For the material in the following chapter, the author wishes to acknowledge his indebtedness to "Die Gonorrhœ des Mannes," by Dr. Hans Wossidlo, Berlin, 1903.

Normal Appearances of Anterior Urethra.—I. Observe the surface of the funnel-shaped figure which the urethral walls assume beyond the end of the endoscope.

II. The central figure: *i.e.,* appearance presented by the closed lumen of the urethra, which forms the apex of the funnel.

The folds of mucous membrane radiate from the central figure outward toward the periphery. Their thickness and number indicate if the mucous membrane be infiltrated, and are of diagnostic importance.

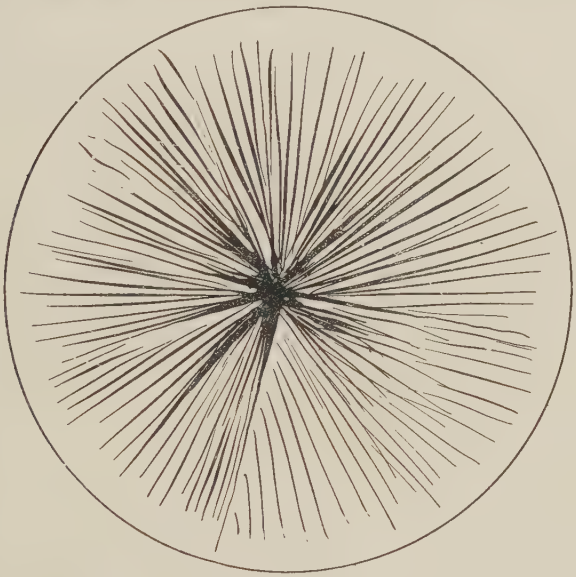

Fig. 54.—Urethroscopic picture of a normal urethra, showing a multitude of fine folds and small central figure.

Longitudinal red stripes running toward the central figure are also noted, and indicate a normal uninfiltrated condition of the mucous membrane.

The surface of the mucous membrane is smooth and glistening and with a distinct luster; its color is ordinarily pale and rosy, but if normally hyperemic may appear distinctly red or purple, without being diseased.

The openings of *Morgagni's crypts* appear in the roof of the urethra as red specks or small slits as large as a pin's head, but the ducts of Littré's glands are not visible in a normal case.

The posterior urethra presents substantially the same appearances as the anterior, except that in addition the *verumontanum* is seen upon the floor of the urethra, looking like a fold of mucous membrane.

In exceptional cases the ejaculatory ducts can be seen as little dots alongside the verumontanum.

By means of the urethroscope Oberlaender classifies chronic gonorrhea into two groups of inflammatory processes:—

I. *Soft infiltration,* which consists in a submucous infiltration of small round cells with increased development of the capillary vessels, and

II. *Hard infiltration,* which includes all the inflammatory processes through which the soft infiltration is converted into fibrous connective tissue, of which its highest degree is stricture.

The character of the diseased process will be markedly influenced by the participation of Morgagni's crypts and Littré's glands, and Oberlaender divides the hard infiltration into two forms:—

(*a*) *Glandular form,* and

(*b*) *Follicular or dry form.*

In the glandular form the ducts remain open and the glands are inflamed, while in the follicular or dry form the glands are entirely obliterated or changed into closed follicles.

URETHROSCOPIC FINDINGS IN CHRONIC ANTERIOR URETHRITIS.

Soft Infiltration.—By introduction of urethroscope, no resistance is felt, but the mucous membrane bleeds easily from contact with the tube.

The *mucous membrane* on the diseased spot appears distinctly hyperemic and of a brighter red than on the normal spots.

The *epithelium* on the diseased spots shows an increased luster, is softened, and desquamates easily. On isolated spots the epithelium has entirely disappeared, leaving small *erosions,* or bright-red granulations which bleed easily. Particularly in the region of the bulb we find, after the rest of the urethritis is cured, granulations which are a cause of the persistent shred formation.

The softened congested mucous membrane, as may be expected, does not lie in as many folds as normal. The long folds are obliterated, and in place of the numerous fine folds radiating from the central figure, we see only three or four broad, softened folds.

The central figure presents itself as a wide and gaping opening, with the mucous membrane often bulging into the end of the tube, or it may be a crescent-shaped slit which is nearly closed.

The inflammation of Morgagni's crypts shows itself through softening and hyperemia of their mouths. These appear as red eminences, pinhead size, with swollen walls, and often discharge a mucous or purulent secretion.

It is easy to secure the secretion for microscopic examination by the *secretion spatula,* or *cannula.*

When the mucous membrane is very soft and hyperemic it is difficult to see Morgagni's crypts, and Littré's glands are never visible with soft infiltration.

Hard Infiltration.—The second stage of the chronic inflammatory process begins with the appearance of connective-tissue fibers in the round-celled infiltration, and is the so-called *hard infiltration* of Oberlaender.

In the beginning, when the amount of connective tissue present is

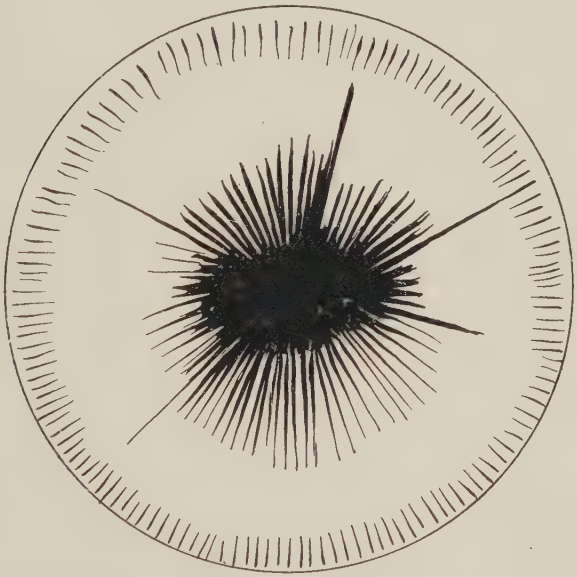

Fig. 55.—Urethroscopic picture of soft infiltration of the mucous and submucous tissues. The central figure is wide and gaping, and the folds of thickened mucous membrane are few in number and coarse and broad.

slight, and the hyperemia and swelling of the mucous membrane are marked, the urethroscopic appearances are those of the soft infiltration, but as the submucous connective-tissue infiltration thickens, the blood circulation in the mucous membrane is shut off and it loses its bright-red color as well as its turgescence and elasticity.

In the worst cases, as a result of the connective-tissue hyperplasia and scar-tissue contraction, the mucous membrane on the diseased spots is converted into a rigid, resisting tissue.

These different phases of development give, naturally, different urethroscopic pictures.

On introducing the tube one feels the resistance caused by the diminished dilatability of the walls, until as the stricture progresses, it may not be possible to introduce even the smallest tube.

A change in the *color of the mucous membrane* is also noted with the urethroscope.

When the infiltration is slight in amount, the diseased spots appear paler and more anemic than the healthy portions; with increasing thickness of the infiltration, the color becomes grayish white or yellowish white; and by marked stricture formation, a uniform gray-white appears.

Under the disturbances of nutrition the *epithelium* also suffers.

In the description of the pathological anatomy of chronic gonorrhea,

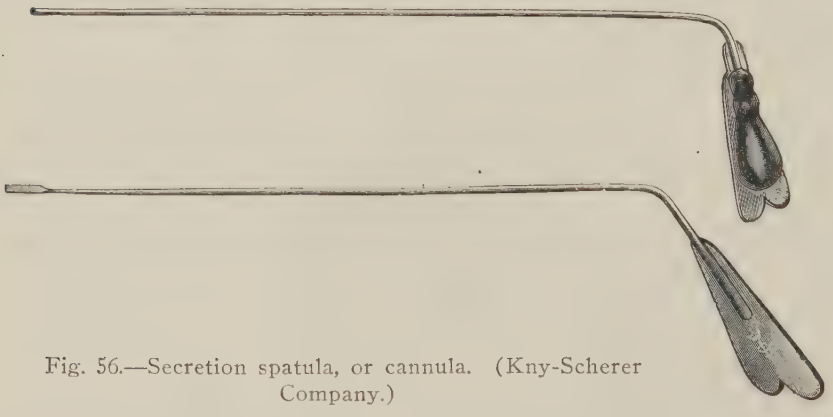

Fig. 56.—Secretion spatula, or cannula. (Kny-Scherer Company.)

the change of cylinder epithelium into compact, many-layered, squamous epithelium and its cornification have already been described.

Slight degrees of hard infiltration are characterized by a diminution in the normal luster and transparency of the epithelium. In consequence of the desquamation, the surface appears stippled and uneven.

As the process extends it tends to localize itself on the most diseased spots, and in severe cases extends over a considerable area, so that finally a thick epithelial layer, or pachydermia, develops.

Under the urethroscope, the epithelial surface appears irregularly lumpy, with these high degrees of infiltration.

In other cases one finds various large, round, pearl-gray-colored spots as large as a pin's head, which rise abruptly from the mucous membrane.

As a result of the infiltration, the thickened mucous membrane is no longer able to lie in *longitudinal folds.*

By slighter grades of infiltration, four to six broad, coarse folds may be noted, and in cases where the infiltration is more marked the folds

are correspondingly fewer, until in the highest grade of infiltration the folds have disappeared entirely and the urethra appears at the end of the urethroscope as a stiff, inelastic tube with smooth walls.

The shape of the central figure is changed into a star-shaped and lengthened funnel.

The above-described changes in the mucous membrane, which occur as a result of the hard infiltration, are also participated in by the urethral glands. Oberlaender divides hard infiltration as (*A*) *glandular form* and (*B*) *dry form.*

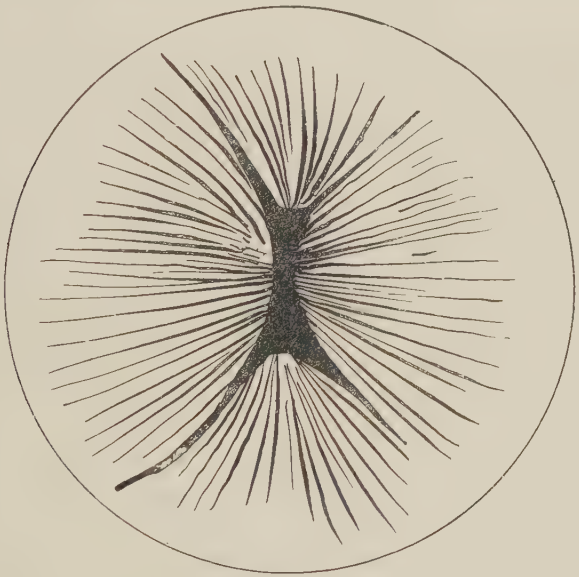

Fig. 57.—Urethroscopic picture of hard infiltration of the submucous tissues. The central figure is open, gaping, and very irregular in shape.

A. Urethroscopic findings in the glandular form:—

As a result of the loss of the epithelium the ducts of *Littré's glands* become visible.

Lying in groups, they appear enlarged and surrounded by an inflammatory zone.

The openings sometimes appear like craters, and secretion is seen issuing from them.

Morgagni's crypts show similar changes, and their swollen and gaping openings, with mucopurulent secretion issuing from them, appear distinctly surrounded by infiltration.

When the periglandular infiltration is so strongly marked, the ducts

of the glands are elevated above the surface and are seen as small, red protuberances.

B. Urethroscopic findings in the **dry or follicular form.**

From the compression of the scar-tissue forming the periglandular infiltration, the ducts of Littré's glands are closed and the glands themselves obliterated or transformed into subepithelial cystic cavities filled with colloid masses.

The ducts of Morgagni's crypts also become obliterated and the gland contents become inspissated and thickened.

The urethroscopic picture of this form of hard infiltration is very distinctive. It is characterized by the fact that there are none at all, or very few, gland-duct openings visible.

Here and there may be seen, at the location of a duct-mouth, a small white or yellow glistening prominence, which denotes the closed follicle and can be felt by palpation of the urethra as a hard nodule the size of a millet-seed.

In proportion to the grade of the hard infiltration, the changes in the mucous membrane are more or less marked.

Longitudinal folds have more or less disappeared.

The *epithelium* appears, in this form, notably dull, without luster, and desquamates in large pieces and gives to the observer the impression of dryness.

Not infrequently both dry and glandular forms of infiltration are found side by side, and are described by Oberlaender as the *mixed infiltration.*

URETHROSCOPIC FINDINGS IN CHRONIC POSTERIOR URETHRITIS.

The technique of posterior urethroscopy differs considerably from the examination of the anterior urethra.

The patient is placed in the lithotomy position, and, while the posterior urethra can be examined with the straight tubes used for the anterior urethra, the introduction past the cut-off muscle is somewhat difficult.

The best instrument for examining the posterior urethra is the recently devised water endoscope of Wossidlo or Goldschmidt, and with these instruments a wonderfully clear and magnified picture of the urethra is obtained. The colliculus can be closely examined, polypi detected, and even the orifices of the ejaculatory and prostatic ducts may often be seen.

The author regards these only as instruments for diagnosis, however, and for making applications prefers a curved posterior urethroscope,

with a movable light and without the water attachment devised by Dr. Geo. K. Swinburne, of New York.

The same pathological alterations which have been described in the anterior urethra also occur in the posterior urethra, and can be detected with the urethroscope. One finds here, also, soft and hard infiltration, and the latter can be divided into various grades.

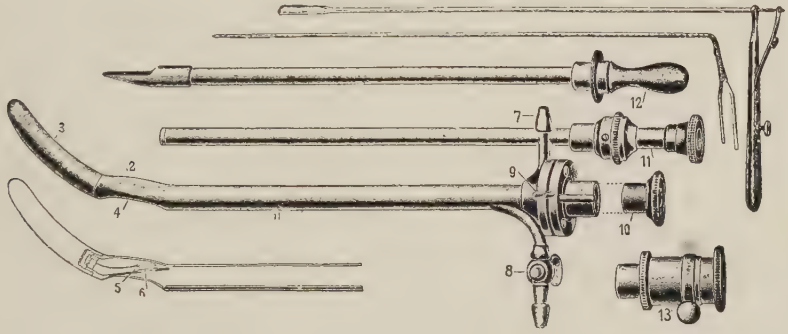

Fig. 58.—Wossidlo's irrigation urethroscope for the posterior urethra, with galvanocaustic point and brush for applications to the colliculus.

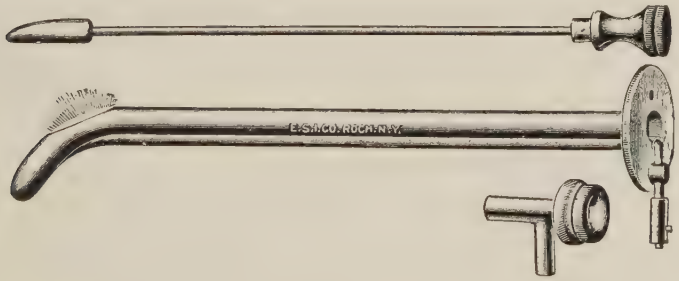

Fig. 59.—Swinburne's urethroscope for the posterior urethra.

With the **soft infiltration** the mucous membrane is bright or bluish red in color, swollen, bleeds easily, and the epithelium has a faint luster.

The verumontanum is swollen and enlarged, and projects upward into the tube. Its surface is either smooth or lumpy and furrowed, and often resembles a raspberry.

The openings of the prostatic sinuses are generally not visible on account of the swelling.

The mouths of the ejaculatory and prostatic ducts show, when they are visible, swollen walls and gaping orifices.

The **hard form of infiltration** gives changes analogous to those described as occurring in the anterior urethra, although, on account of

the absence of visible glands, they are more uniform and resemble more the dry form of the hard infiltration.

The mucous membrane appears pale red or grayish yellow in color, and dry and lusterless.

If the verumontanum has been attacked by the connective-tissue infiltration, it is yellowish in color, with a dulled epithelial luster, and is flattened and smooth on the surface.

In high degrees of hard infiltration, one finds horizontal, thread-like scars, and the parts of the mucous membrane lying above them are dry and grayish yellow in color.

UNUSUAL CONDITIONS OBSERVED WITH THE URETHROSCOPE.

In addition to the changes above described, which are commonly met with, certain conditions are sometimes seen.

Papillomata resembling the vegetations occurring on the prepuce are occasionally found. They may fill the urethra to such an extent as to interfere with urination; and if they occur in the posterior urethra, lead to marked reflex disturbances of the nervous system.

Cysts formed by the retention of secretion in the urethral glands or Cowper's glands have been observed by Fenwick, Grünfeld, and others. They are of extreme rarity.

Psoriasis mucosæ is observed as snow-white spots, not elevated above the surface, and formed of masses of pavement epithelium closely adhering together.

Changes of color sometimes result from the frequent use of nitrate of silver, and appear most often as bluish-black spots, in the vicinity of the gland openings, or even sometimes as extensive spots of discolored mucous membrane.

TREATMENT OF THE ANTERIOR URETHRA.

The urethroscope is a useful instrument for diagnosis, but is of little value in the treatment of chronic urethritis, for, while granulations and erosions may be cauterized through the endoscopic tube, the submucous infiltration upon which they depend cannot be reached by a superficial application, but requires the pressure of dilatations to cause its disappearance.

The application of remedies is made to the diseased surface by means of a tampon of cotton wrapped around a stick[1] and introduced through the endoscopic tube. The principal *drugs* in use are: nitrate

[1] The sticks which florists use for tying on to the ends of cut flowers answer the purpose.

of silver, from 10 to 100 grains to the ounce; iodine and carbolic acid, equal parts; sulphate of copper, 25, 50, or 100 grains to the ounce, and bichloride of mercury, in 1 per cent. alcoholic solution.

The intervals of treatment depend upon the amount of reaction; every three days for mild solutions and from five to seven days for strong ones are about the average. After improvement begins intervals should be increased to ten days. The first application should always be mild; 10 grains to the ounce is strong enough to begin with, and it may be increased later if desired.

In regard to the selection of the appropriate remedy, it may be said in a general way that a diffuse hyperemia calls for milder solutions of nitrate of silver: 5 or 10 grains to the ounce. Granulations require strong solutions of nitrate of silver, from 50 to 100 grains, or carbolized iodine. For erosions mild solution of nitrate of silver, 5 or 10 grains to the ounce, is the best, while for inflamed glands carbolized iodine answers well.

Sometimes a localized area of granulations in the bulbous region may cause a continuance of the discharge, and in these cases, which do not clear up after dilatation, topical applications through the endoscope of a 10 to 20 per cent. nitrate-of-silver solution rapidly destroys the granulations.

Morgagni's crypts are often the seat of a chronic inflammation, and afford opportunity for the growth of colonies of gonococci, which cause relapses of an apparently cured gonorrhea. They can be disposed of like any other suppurating sinus, by destroying them with the galvano-caustic needle, through the urethroscope under the guidance of the eye.

Papillomata of the urethra can be removed by a wire loop or destroyed by electrolysis.

In the **posterior urethra** local treatment through the endoscope is often indispensable.

The prostatic urethra requires the strongest applications of nitrate of silver; but under inspection, if the lesions do not improve, the strength of the solutions can be increased or their character changed, as occasion requires.

In chronic posterior urethritis, with a good deal of inflammatory swelling of the verumontanum, cauterizing it with a 20 per cent. nitrate-of-silver solution (100 grains to the ounce), as advised by Burckhardt and Wossidlo, often gives brilliant results, and the various reflex nervous disturbances disappear very rapidly.

Tincture of iodine may be used as an absorbent, and when the nitrate of silver causes excessive pain Frank advises the use of trichloracetic acid, 5 or 10 per cent., as a caustic, and in very resistant cases burning

the colliculus with the red-hot galvanocaustic point usually results in a cure.

Geraghty describes a chronic infective inflammation of the prostatic utricle, causing frequent relapses of a posterior urethritis which was cured by injecting the utricle with a 5- to 15- grain nitrate-of-silver solution, once a week, for a few times.

RÉSUMÉ OF THE DIAGNOSIS, PROGNOSIS, AND TREATMENT OF CHRONIC URETHRITIS.

In examining a case of chronic urethritis, it is desirable to proceed in a systematic way, so that important points may not be overlooked, and the author finds the following scheme a satisfactory one in practice:

The **patient's history** is first obtained, and the number, duration, and attendant complications of previous attacks of gonorrhea are noted.

The surgeon next inquires about the *present attack,* ascertaining how long it has lasted, what treatment has been used, the amount of discharge, and whether frequent and urgent urination is present. The patient is asked about his *mental symptoms,* whether he is despondent, irritable, and depressed.

The *sexual symptoms* are inquired into, and the patient is asked if, on coitus, the ejaculation is premature and if the erections are firm; also if seminal emissions occur and how frequently, and if by night alone or in the day as well. (Prostatorrhea, spermatorrhea.)

The physical examination is then begun, and the *testicles* are examined for varicocele, epididymitis, or orchitis. The *meatus* is inspected, to see if it is too small or if hypospadias is present.

Smears of the pus discharging from the urethra are made on two cover-glasses.

The patient is then requested to pass a small quantity of urine in a glass.

The contents of **glass 1** are observed, to note if the urine is turbid or clear and contains clap-shreds. If the urine is turbid from *phosphates,* the addition of a few drops of nitric acid will cause it to clear up.

If the urine, however, is turbid from *pus,* it is an important contraindication to any urethral instrumentation, and the patient is put on irrigations until the pus disappears and the urine is clear, with shreds floating in it. When this result is attained it is proper to begin instrumentation of the urethra, and not before.

If the bladder contains a sufficient quantity of urine upon the first visit, the two-glass urine test may be made, and the contents of **glass 2** noted. The presence of pus in the second glass indicates

involvement of the posterior urethra, although in certain conditions the Jadassohn-Van Zeissl method must be used to determine this point.

If there is only a small quantity of urine in the bladder, we can omit securing glass 2 and proceed directly to the **examination of the rectum.**

With the patient in the leap-frog position, the *prostate* is examined, to ascertain whether it is enlarged, and, if so, whether it is *hard* or *soft.* The upper border is sought for, to find or exclude perivesiculitis.

The condition of the *seminal vesicles* is ascertained, and the surgeon notes if they are soft and distended, or hard and painful.

The contents of the seminal vesicles and prostate are then expressed and squeezed through the ejaculatory and prostatic ducts into the posterior urethra.

Immediately after the stripping the patient urinates into a glass, thus washing out of the urethra the secretions of the prostate and vesicles which have just been expressed. This mixture of prostatic and vesicle secretion and urine is termed **expression-urine** and is always carefully inspected. If the prostate and vesicles are healthy, the expression-urine is only slightly milky in color, but if these organs are diseased, the expression-urine contains heavy masses, shreds, or free pus, which sinks to the bottom of the glass on standing.

Instead of collecting the expressed prostatic secretion in the urine, it may be caught on a glass slide and, after drying, stained and examined with the microscope.

The author believes that obtaining a knowledge of the condition of the prostate and vesicles is the most important step in the whole examination, for these structures may harbor gonococci for months, and possibly for years.

Disease of these organs is responsible for innumerable cases, where innocent wives have been infected with gonorrhea by their husbands, the causation of impotence, and, in the light of recent pathological research, may perhaps be the cause of the enlargements of the prostate which occur in old men.

The expression-urine should always be examined microscopically.

If normal, the sediment is found to contain mucus, granular phosphates, and spermatozoa. Sometimes amyloid bodies and phosphatic concretions are present, and Böttcher's crystals appear on adding 1 per cent. solution of phosphate of ammonium.

Disease of the prostate and vesicles is denoted by the presence of pus-cells. Gonococci may or may not be found; but if much pus is present, the likelihood of the existence of gonococci is very strong.

In doubtful cases attempts have been made to prove the presence or absence of gonococci by making cultures from the prostatic fluid on hydrocele-agar. It is very difficult to grow the gonococcus, and they may exist in the prostate without appearing upon the culture plates.

Provocative instillations of nitrate of silver, gr. v to the ounce, into the posterior urethra, followed in twenty-four hours by massage of the prostate and microscopic examination of the expressed secretion, is much more liable to disclose the gonococci if still present than attempts at cultivation.

The next step in the examination consists in **exploring the urethra,** provided the urine is clear and contains only floating shreds.

The *urethrometer* may be used for two purposes, but the author prefers a flexible *bulbous bougie,* with which a hard or soft infiltration can be easily recognized.

The findings of the bulbous bougie may be confirmed and additional light thrown on the case by the **urethroscopic examination.**

The most important pathological feature of chronic urethritis is the *infiltration,* for the erosions and glandular changes depend upon it. With the urethroscope we are able to determine if the infiltration is hard or soft, and we can also observe the presence of erosions, glandular changes, and granulations.

The posterior urethra is more difficult and more painful to examine than the anterior. The chief points of interest are the verumontanum and the color of the mucous membrane, which in diseased conditions is purple and rough and bleeds freely.

After completing the examination of a patient in the manner thus detailed and deciding what parts are affected; if the anterior urethra alone is involved, or if both anterior and posterior urethras are affected, and complicated perhaps by prostatitis or vesiculitis, we are in a position to begin the treatment of the case.

In most cases of chronic urethritis we find that there is a chronic inflammation, with more or less infiltration, affecting both anterior and posterior urethras, and that in addition the prostate is generally involved, and frequently the seminal vesicles as well.

METHOD OF EXAMINING A CASE OF CHRONIC URETHRITIS.

First Day.

History: Take in detail.

I. Inspect pus squeezed from meatus.

II. Examine urethra with bulbous bougie or urethrometer.

Second Day.

III. Wash out shreds and secretion from anterior urethra.

IV. Patient urinates in glass No. 1. No. 1 contains washings from posterior urethra.

V. Examine prostate and seminal vesicles per rectum.

VI. Patient urinates in glass No. 2. No. 2 contains expression-urine from prostate and seminal vesicles.

VII. Examine shreds and pus secreted by urethra, microscopically.

Third Day.

VIII. Examine urethra with endoscope unless a considerable portion of the mucous membrane is inflamed and secreting pus freely.

PROGNOSIS.

The duration of chronic urethritis is always protracted and requires great patience on the part of physician and patient. From the experience of the leading genito-urinary specialists in this country and Europe, as developed by the results of the investigations of the committee of the American Medical Association, six months may be accepted as the average duration of the treatment of chronic gonorrhea, while in the experience of some of the reporters about 3 per cent. of the cases were incurable by any treatment whatever.[1]

The test as to when the patient is cured is the *permanent absence of pus-cells* and *gonococci in the urethral secretions.*

When all discharge has ceased from the anterior urethra, in order to get material for microscopic examination it is necessary to inject a syringeful of 2 per cent. nitrate-of-silver solution into the anterior urethra. A free discharge of pus follows, which ceases in twenty-four hours. If no gonococci are found in the resulting secretion after microscopic examination of several smears, it is safe to conclude that the micro-organisms have all been eliminated from the urethra in front of the cut-off muscle.

The secretions of the prostate and seminal vesicles should be expressed by the finger in the rectum and examined at the same time. It is from these organs that the chief danger of infection comes after discharge has ceased from the meatus, and they are responsible for the majority of cases of infection of wives and mistresses. In examining the expressed secretions from the prostate and vesicles it is not enough to demand absence of gonococci; we should insist upon an *absence* of

[1] Social Diseases and Marriage, Morrow, 1904.

pus-cells, for if pus-cells are present there may be an occasional gonococcus in a cell which might easily be overlooked.

Provocative instillations into the posturethra of nitrate of silver, gr. v to the ounce, followed by massage of the prostate, are more useful in disclosing the presence of gonococci than cultures, for this organism often refuses to grow, especially in chronic cases.

It is estimated that one-eighth of all the diseases of women are occasioned by gonorrheal infection attacking the vagina or cavity of the uterus, and thence extending to the Fallopian tubes and ovaries. In view of these facts, a patient who has suffered from chronic gonorrhea should only be allowed to marry when examination shows:—

I. Absence of gonococci from the anterior urethra.

II. Absence of pus-cells from the expressed secretion of prostate and vesicles.

III. Freedom from stricture.

IV. A healthy normal condition of prostate and seminal vesicles.

Instead of making the examination on three days as described on the preceding page, the entire procedure can be completed at one sitting if the following order is adopted:—

The routine examination to determine if a man is a proper candidate for marriage, as employed by the author, is as follows: The discharge from the meatus has ceased and the urine is clear and free from pus shreds. (Filaments composed of squamous epithelium are innocuous.)

I. Patient urinates, retaining a part of the urine in the bladder.

II. Prostate and vesicles are examined per rectum. Note outlines, consistency, and if perivesiculitis be present.

III. Collect expressed secretion on glass slide as it issues from meatus, or centrifuge expression-urine for sediment.

IV. Make slides, stain, and examine with microscope. Presence of pus-cells denotes disease of prostate or vesicles even though no gonococci be found.

V. Examine anterior urethra with bougie à boule to determine presence or absence of stricture, and confirm by examination with urethroscope; also note if Morgagni's crypts are gaping, inflamed, and if pus is issuing from them.

VI. Inject nitrate of silver solution, gr. x to ounce, into anterior urethra, to excite suppuration.

VII. Make 2 smears of resulting discharge four to twelve hours after injection, stain, and examine with microscope for gonococci.

Certain cases of chronic urethritis suffer from *excess* of *treatment,* and the inflammation is maintained by the irritation produced by the local applications.

After a case has been under treatment for a couple of months, it is always desirable to stop all injections or instillations for ten days in order to make sure that the natural process of recovery is not retarded by overtreatment.

Entire disappearance of *shreds* is not to be looked for. The erosions have been covered with many layers of squamous epithelium, and continuance of desquamation of the upper layers goes on as the new cells are formed in the depths.

The shreds appear as thin filaments which float in the urine, and microscopic examination shows them to be composed of squamous cells alone without containing any pus-corpuscles.

TREATMENT.

In beginning the treatment of a case of chronic urethritis, the condition of the urine indicates the therapeutic measures to be adopted. If the urine is cloudy and turbid from pus in both glasses, as is generally the case, urethrovesical irrigations should be used until the urine no longer contains pus, but only shreds.

If gonococci are still present, the best drug to use is albargin, 1 : 1000.

If gonococci are not evident and the discharge is scanty and the urine is clear, with shreds, nitrate of silver, 1 : 4000, may be used, and if gonococci are present the discharge will be increased at once. If there is a considerable amount of suppuration without gonococci, permanganate of potash, 1 : 3000, is a suitable remedy.

In the author's experience, a subacute urethritis with a *moderate amount of discharge* from the urethra is usually best treated by albargin, 1 : 1000, or 1 : 3000 permanganate irrigations, while a *slight discharge* of pus or the presence of *abundant heavy shreds* requires irrigations every second day with nitrate-of-silver solution from 1 : 10,000 to 1 : 2000.

After continued irrigations, when the urine has become *clear with shreds* floating in it, it is proper to begin *dilatations,* with the object of causing absorption of the round-celled infiltration. The infiltration exists in greater or less degree in practically every case of chronic urethritis, and must be gotten rid of, to prevent stricture and allow the superficial lesions to heal.

It is better to begin the dilatation with *sounds,* after cutting the meatus if necessary. When the limit has been reached with a sound, which is from 28 to 32, the treatment should be continued with the *Kollmann dilator.* After each dilatation, the urethra should be irrigated with 1 : 4000 nitrate-of-silver solution.

Instead of using the sounds, dilatations with the Kollmann irrigating dilator may be begun at once.

While treating the urethra, it is highly important not to overlook the prostate and seminal vesicles, for the prostate is affected in nearly every case of long standing, and very frequently the seminal vesicles as well.

The prostate and vesicles should be massaged regularly, twice a week, to empty the prostatic tubules of inflammatory products and to cause the absorption of the perivesicular infiltrations.

After each massage or stripping, an intravesical irrigation of nitrate-of-silver solution, albargin, or oxycyanide of mercury, or in very chronic cases an instillation into the posterior urethra with an Ultzmann syringe, should be employed.

Massage of the prostate and dilatations of the urethra should not be used on the same day, on account of causing too much irritation.

The surgeon should also remember that treatment of any kind, if continued for too long, causes in itself that which maintains the disease in the urethra. It is always well to stop all treatment for a few days, every two or three months.

The treatment as above outlined, consisting in irrigations and dilatations of the urethra, with massage of the prostate and vesicles, will be all that is required in most cases. When, however, a patient fails to get well, it usually implies that some focus of infection, often in one of Morgagni's crypts, is still present which has been overlooked, that a constitutional diathesis exists, or the treatment has been incorrectly applied.

The patient should clearly understand before beginning treatment that it will require from three to six months before he is cured, for if he knows at the outset the length of time needed he will be less apt to grow impatient at the apparent slowness of his progress and abandon treatment before he is well.

CONSEQUENCES OF UNCURED GONORRHEA.

I. TO THE MAN.

(*a*) *Local.*

The more remote effects of gonorrhea have an important influence on the general economy. The local lesions of prostatitis and seminal vesiculitis are followed by a train of nervous symptoms and attended by a condition of impotence; epididymitis generally results in sterility; if a stricture occurs in the urethra, it may be followed by impotence and all the serious consequences of obstructed urinary outflow, and in the most recent times some connection is thought to exist between a gonorrhea and the development in old age of a hypertrophied prostate.

(*b*) *General affections.*

The discoveries of the past few years in connection with the gonococcus have demonstrated that gonorrhea is not a purely local disease, but it may be regarded as a systemic general infection, with local manifestations, for the gonococci are carried through the lymphatics and deposited in various serous membranes. A common manifestation of this infection is noted in the inflammation of white fibrous tissue of joints and the endocardium and pericardium, but the meninges of the brain and cord may also be attacked.

The kidney also suffers and a pyelitis may develop, either as a result of the direct local extension from the urethra, or perhaps from hematogenous infection.

The *duration* of gonorrhea depends on the longevity of the gonococcus, and this organism may live for years after its first introduction into the body.

Morrow reports one case of contagion four years after infection, and another one after six years.[1]

II. EFFECTS UPON THE FEMALE.

The consideration of the effects of gonorrhea upon the female may be considered under three heads:—

(*a*) The increased risk to the life and health of the woman.

(*b*) The effects in inducing sterility.

(*c*) The effect upon the infant, in causing abortion, premature birth, ophthalmia neonatorum, and blindness.

The medical profession has not accepted its share of responsibility for these results!

Physicians are too apt to allow a patient showing but slight symptoms to marry, either from careless examination or an unwarrantable ignorance of the symptoms of an uncured gonorrhea and its serious consequences to the wife and mother.

In most cases of postmarital infection, the men have honestly believed themselves cured, and in many cases they have been assured that it was safe for them to marry.

The physician fails in his duty if he does not satisfy himself, by rigorous and exhaustive tests, of the patient's freedom from contagion before he sanctions marriage, and if he does not enlighten the patient fully and thoroughly as to the dangers to which he will expose his wife from the terrible complications of gonorrhea, until he can carry out his intentions with safety.

Long before the discovery of the gonococcus, Noeggerath recognized the pathogenic influence of gonorrhea upon the pelvic organs of women,

[1] Social Diseases and Marriage, 1904, Prince W. Morrow.

and boldly incriminated latent gonorrhea in men as the active factor in the production of these inflammations and the oft-resulting sterility.

At the time, his views were held to be wild vagaries, but at the present day we know that he was right.

While the pathogenic organism is the same in man and woman, the effects of the activity of the gonococcus are differently shown, on account of the material differences in the female genital organs. The greater extent of the tract in women permits a larger field for infection, by continuity of tissue.

The situation of the uterus and ovaries in the pelvic cavity, and their proximity to the peritoneum, all increase the gravity of the infection with the gonococcus. This is also further modified by the periodical congestion at the menstrual period, and especially the changes induced by the puerperal state.

The source of infection in women is almost invariably *chronic gonorrhea* in the man, for the reason that in acute gonorrhea coitus is painful, and also because most men have enough conscience to abstain from intercourse during the acute period.

In chronic gonorrhea, however, the symptoms are very trifling and may be easily overlooked.

The infection may take place in the vagina, but more frequently the organisms are deposited in the cervix at the time of ejaculation.

The inflammation remains localized for a time, until the congestion of the menstrual period or pregnancy determines the extension of the process.

The inflammation then ascends, and the endometrium, tubes, ovaries, and eventually the peritoneum are in turn attacked.

The disease is insidious while in the endometrium, and often occasions only trifling symptoms, and the woman is entirely unconscious that she has a serious infection until the tubes or ovaries are attacked.

Another reason why the infection is overlooked, is because in men the gonococci, after propagating for months upon the same soil, lose their extreme virulence, and when transplanted to the female their action depends upon the accident of their location.

If their new habitat is the urethra, they find a favorable soil and develop active inflammatory symptoms; if the primary infection is in the cervix, they are more apt to pursue a torpid, slowly proliferating character, for the reason that some special excitation is required to arouse them from their dormant, inactive state and endow them with exalted virulence.

The determining cause is found in the function of menstruation, which causes congestion and increased flow of mucous secretion, and the lochia constitutes an excellent culture-medium for the gonococcus.

It is a well-known fact that a woman with gonorrhea may be innocuous as far as contagion is concerned during the intermenstrual period, but becomes highly contagious immediately after the menses.

When the gonococci gain entrance to the body of the uterus or endometrium proper, general symptoms develop which are more or less pronounced, and with marked exacerbations at each menstrual period, and attended with an increase in the menstrual discharge for some days after the period.

As a result of the changes briefly mentioned, sterility occurs in 50 per cent. of the cases, and a condition of invalidism is brought about, which makes life a burden and deprives the home of her influence and care.

The conditions above outlined are discussed fully in the treatises on gynecology, but it seems appropriate, before dismissing the subject of gonorrhea, to call attention to the conditions which may arise, through ignorance or carelessness on the part of a physician when consulted by a candidate for matrimony.

INFLAMMATIONS OF THE PROSTATE.

CHAPTER VII.

ANATOMY OF THE PROSTATE.

The prostate in shape and size resembles a horsechestnut, and is situated below the bladder and perforated by the prostatic urethra. It

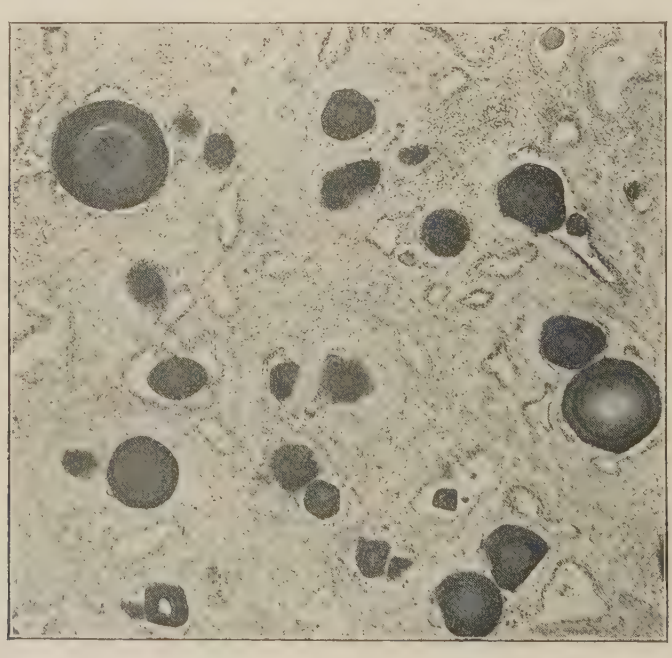

Fig. 62.—Section of normal prostate with amyloid bodies.

is surrounded by a dense, fibrous capsule, which sends thin septa inward, between the glands and among the muscle fibers.

The prostate is essentially a *glandular organ* and is composed of two elements:—

(*a*) A fibrous connective-tissue framework, and unstriped muscular fibers, and

(*b*) Glands, composed of compound branching tubules called acini and lined with secreting epithelium of the cylindrical variety, each containing a nucleus in its lower third and ending in short *ducts*.

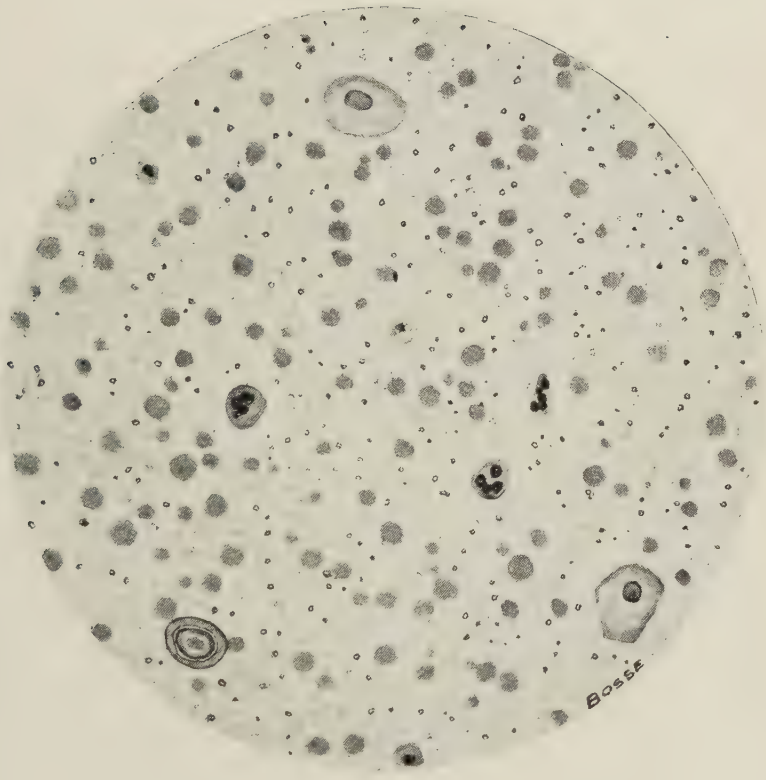

Fig. 60.—Normal prostatic secretion. Lecithin bodies abundant, granular phosphates, an occasional leucocyte, an amyloid body, and a few squamous cells from urethra or bladder. Original drawing from microscopic specimen.

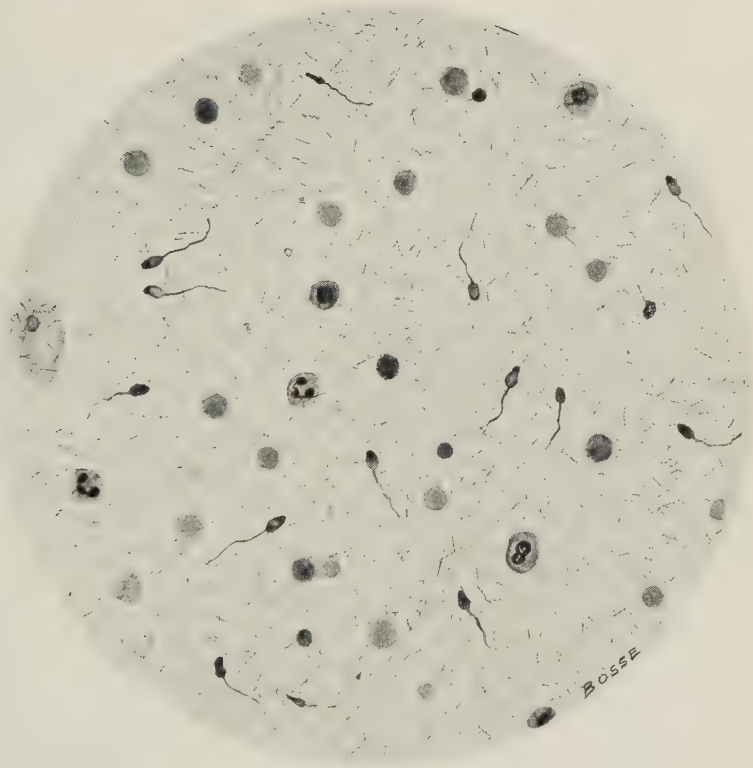

Fig. 61.—Normal secretion obtained by massaging the prostate and vesicles. Lecithin bodies abundant, a few spermatozoa, and an occasional leucocyte. Original drawing from microscopic specimen.

Small, oval bodies are occasionally found within the tubules, which are known as *amyloid bodies*. They are formed from the secretion of the prostatic tubules and broken-down cells; later they may become calcified and form *prostatic concretions*.

The glands are arranged in distinct groups, forming three lobes.

The ducts empty as follows: Those from the lateral lobes empty at the sides of the verumontanum, and those coming from the posterior lobe empty between the verumontanum and the bladder.

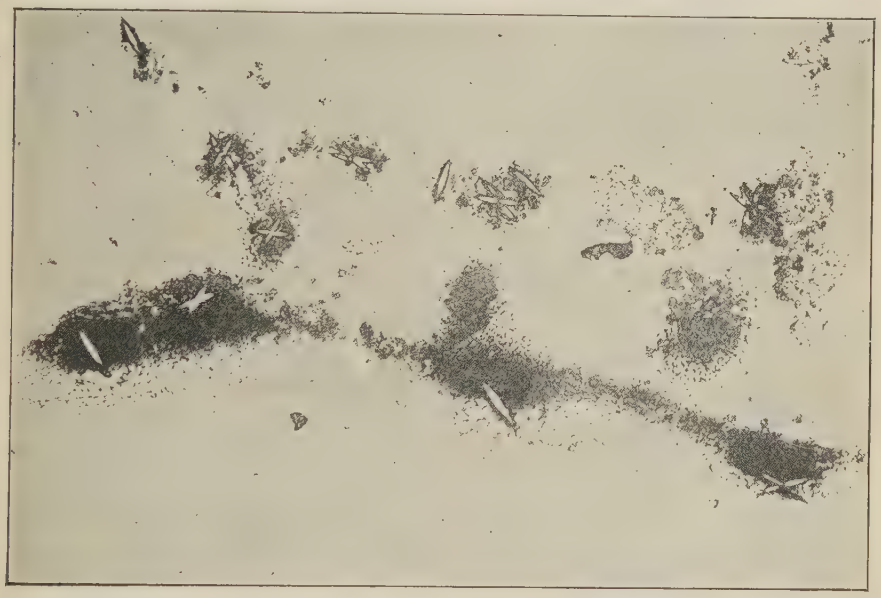

Fig. 63.—Böttcher's crystals.

The prostate is tunneled by the ejaculatory ducts from the seminal vesicles, and which empty by a slit-like orifice into the posterior urethra, within or at the sides of a small depression at the base of the verumontanum, or colliculus seminalis.

SECRETION OF THE PROSTATE.

The prostatic secretion is a thin fluid, milky in appearance and alkaline in reaction, with a peculiar odor which it imparts to semen.

It serves to dilute and render less viscid the secretion from the testicles and seminal vesicles, and exerts a nutritional influence upon the spermatozoa, for observation has shown that the spermatozoa do not become mobile until they have come in contact with the prostatic fluid.

Whether this is due to a mere mechanical dilution of the semen, admitting free movements of the spermatozoa, or whether the prostatic fluid has some direct effect on their nutrition, is still under discussion. Under the *microscope* the normal prostatic fluid is found to contain cylindrical cells, some granular phosphates, and a little mucus.

On adding a 1 per cent. watery solution of ammonium phosphate, *Böttcher's crystals* appear.

These are transparent, dagger-shaped crystals, and Fürbringer claims that their base exists only in prostatic fluid.

In consequence, the presence of these crystals after the addition of 1 per cent. ammoniophosphate solution denotes that the fluid is derived from the prostate.

ACUTE PROSTATITIS.[1]

ETIOLOGY.

Acute inflammation of the prostate is always due to its infection with micro-organisms.

Ninety per cent. of the cases occur in the course of an acute gonorrhea, from an extension of the posterior urethritis and entrance of organisms into the prostatic ducts.

Acute prostatitis is more common than is generally supposed.

Frank[2] examined 651 cases of gonorrheal urethritis; of these, 210 had posterior urethritis, and in every one of these the prostate was diseased.

Acute prostatitis may develop early in the course of gonorrhea. In 96 of Frank's cases it developed in the first week.

The micro-organism which is responsible is generally the gonococcus. In 210 cases of Frank the gonococcus was found 179 times, other bacteria 20 times, and an aseptic secretion with numerous leucocytes was found in 11 cases.

Acute prostatitis may develop in the course of a chronic gonorrhea, as a result of forced injections, injury with sounds, excesses in alcohol or venery, active bodily exercise, or a chilling of the surface from exposure to cold or wet.

These causes all operate either by forcing organisms into the prostatic ducts, or lowering the local resistance of the tissues to infection.

In a very small number of cases acute prostatitis occurs as a result of the passage of the colon bacillus from the rectum or in the course of infectious disease by *metastasis*.

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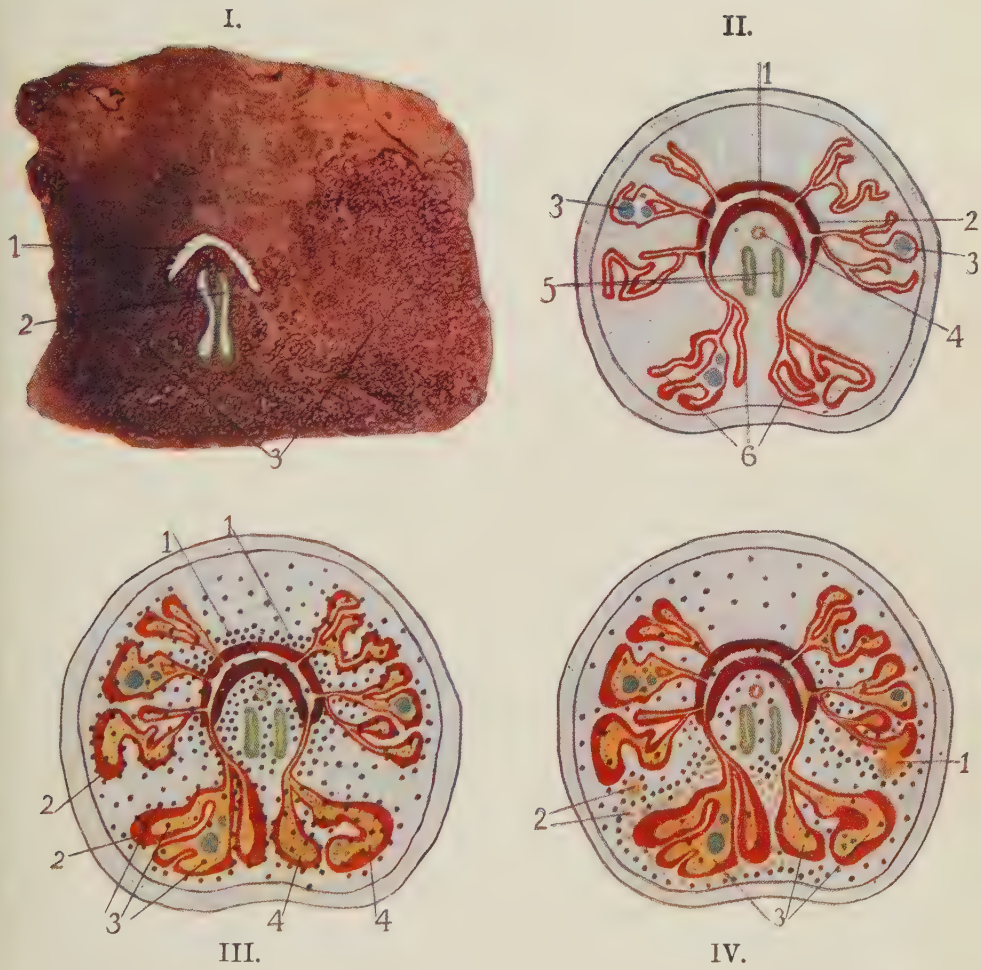
[1] In the consideration of the acute and chronic forms of prostatitis, no reference will be made to the senile hypertrophy of the prostate, which occurs in old men and which is considered later in a separate section.

[2] Medical News, April 26, 1902.



I. Section of a Normal Prostate.

1. Urethra.
2. Ejaculatory ducts.
3. Prostatic tubules.

II. Normal Prostate.

1. Verumontanum.
2. Urethra.
3. Corpus amylaccum.
4. Sinus pocularis.
5. Ejaculatory ducts.
6. Prostatic tubules.

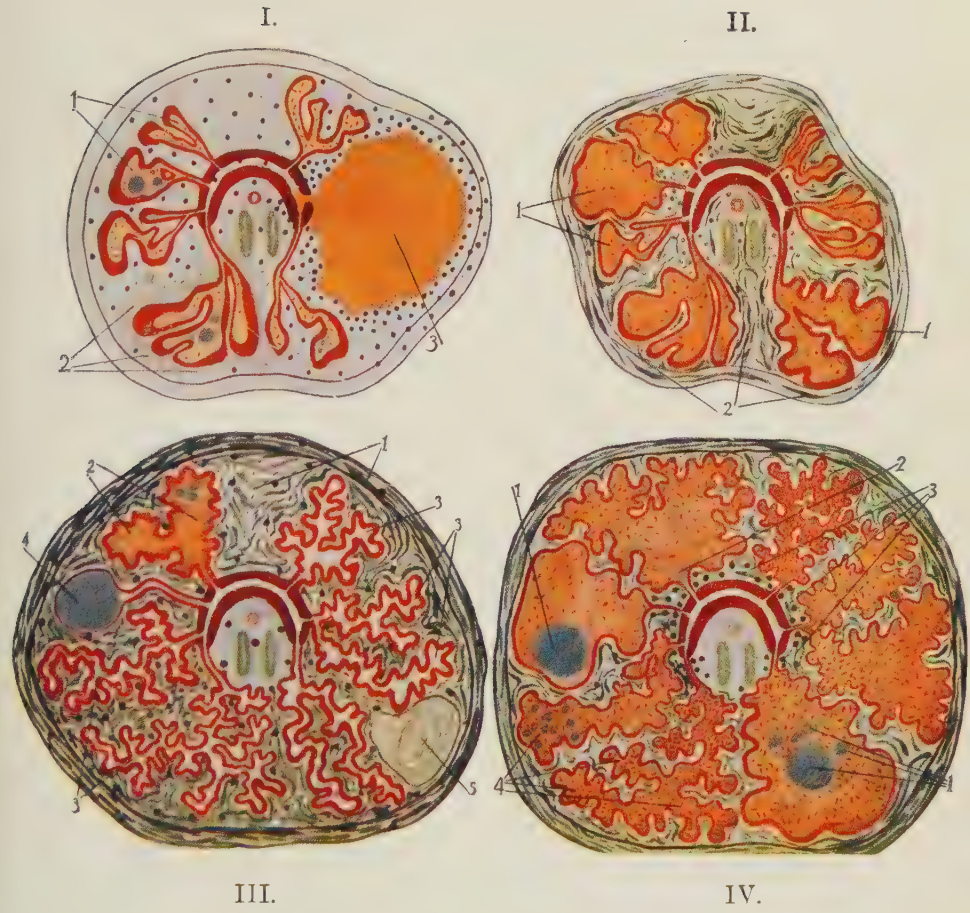
III. Catarrhal Prostatitis.

1. Round-celled infiltration of fibro-muscular tissue.
2. Dilated prostatic tubules—walls thickened.
3. Round-celled infiltration of tubules.
4. Exudate with desquamated epithelium.

IV. Parenchymatous Prostatitis.

1. Small abscess rupturing into tubule.
2. Miliary abscesses.
3. Dilated tubules containing exudate (catarrhal inflammation).

Note:—On account of the difficulty in demonstrating the pathological changes occurring in diseased conditions of the prostate, the above series of diagrams was made, under the direction of Dr. Harlow Brooks, by Mr. J. Henrici, at the author's suggestion, hoping that a diagrammatic representation would make the conditions more intelligible to students.



I. Suppuration of Lateral Lobe of Prostate.

1. Dilated tubules containing exudate (catarrhal inflammation).
2. Interstitial hyperplasia about miliary abscess.
3. Large abscess rupturing into urethra.

II. Chronic Prostatitis.

1. Dilated tubules filled with exudate, pus, and desquamated epithelium.
2. Hyperplastic connective tissue.

III. Hypertrophy of Prostate (Fibroid Type).

1. Interstitial hyperplasia.
2. Dilated tubule filled with secretion.
3. Tubules compressed by increase of interstitial tissue.
4. Encysted amyloid body.
5. Fibroma.

IV. Hypertrophy of Prostate (Adenomatous Type).

1. Amyloid bodies.
2. Duct occluded by amyloid body.
3. Hyperplastic connective tissue most marked about ducts.
4. Dilated tubules containing exudate and desquamated epithelium.

Acute prostatitis occurs in *three forms*[1]:—

I. Catarrhal prostatitis.

II. Parenchymatous prostatitis.

III. Suppuration of the entire prostate.

It was formerly the custom to speak of **congestion of the prostate,** but this term is very vague and indefinite.

We do, however, meet with cases in which, in the course of a gonorrhea or after the introduction of a catheter, a distinct and painful enlargement of the prostate occurs, which is by some authors termed *congestion.* It is probably due to a small, round-celled infiltration, with serous exudation into the parenchyma, and subsides rapidly by absorption.

I. CATARRHAL PROSTATITIS.

PATHOLOGY.

In this form of prostatitis, the prostatic tubules are *dilated,* their epithelial lining is infiltrated with round cells, and is the seat of catarrhal inflammation. The cavities of the tubules are filled with desquamated epithelium and altered catarrhal mucus.

The intertubular substance of the prostate, the fibromuscular tissue, is the seat of a small, round-celled infiltration and serous exudation.

The above changes all lead to an enlargement of the entire organ, and on pressure a turbid white secretion (pus) is expressed.

Healing occurs by absorption of the fluid serous exudate, throwing off of the degenerated epithelium through the prostatic ducts, and regeneration of the epithelium.

SYMPTOMS AND COURSE.

The symptoms of this condition are not very well marked, and they are still further masked by the existing posterior urethritis. The patient complains of a sense of weight and heat in the perineum and pain on defecation and urination. The fever is usually slight, but may be considerable.

On *examination* with the finger in the rectum, a hard, tense, sharply defined swelling is observed, and the borders of the prostate can be distinctly outlined.

The increase in size is variable, sometimes only one lobe is affected, and at other times the gland is not perceptibly enlarged and the diagnosis is only made by sensitiveness on pressure.

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[1] In the chapter on Acute and Chronic Prostatitis the author has made free use of the valuable monograph on the prostate by Socin and Burkhardt, published by Enke, Stuttgart, 1902.

Catarrhal prostatitis generally heals through a discharge of the pus from the small abscess cavities into the urethra, and is followed by their subsequent cicatrization and closure.

Occasionally small foci of pus can become inspissated or calcified.

The process may heal entirely or become chronic.

II. PARENCHYMATOUS PROSTATITIS.

This affection may begin as a *catarrhal prostatitis,* and increase, or begin at once as a parenchymatous inflammation.

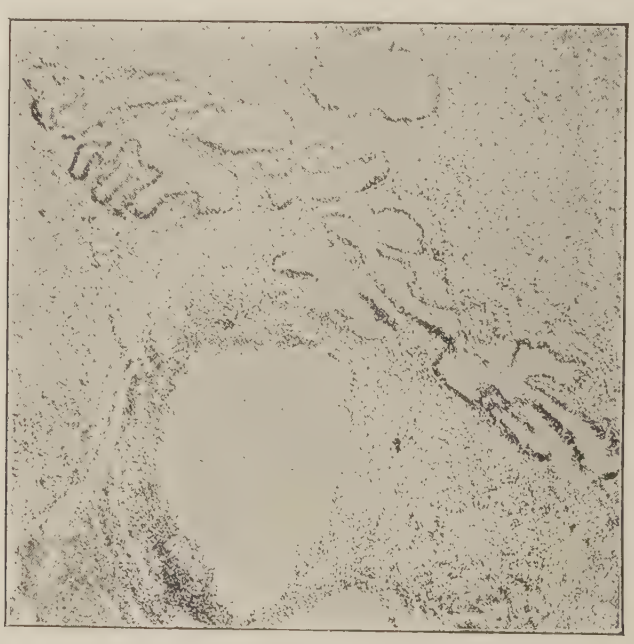

Fig. 64.—Acute prostatitis. Normal tubules and cystic tubules with pus.

PATHOLOGY.

Yellow foci of infiltration form near and between the glandular elements, which, after necrosis of the tissues, liquefy and form a few or many small miliary abscesses. These abscesses are sometimes absorbed, but more generally discharge their contents into the urethra, and the abscess cavities heal by formation of cicatricial scars, which contract and obliterate them.

Sometimes the abscess cavities do not close, but remain open permanently and communicate with the urethra by a fistula.

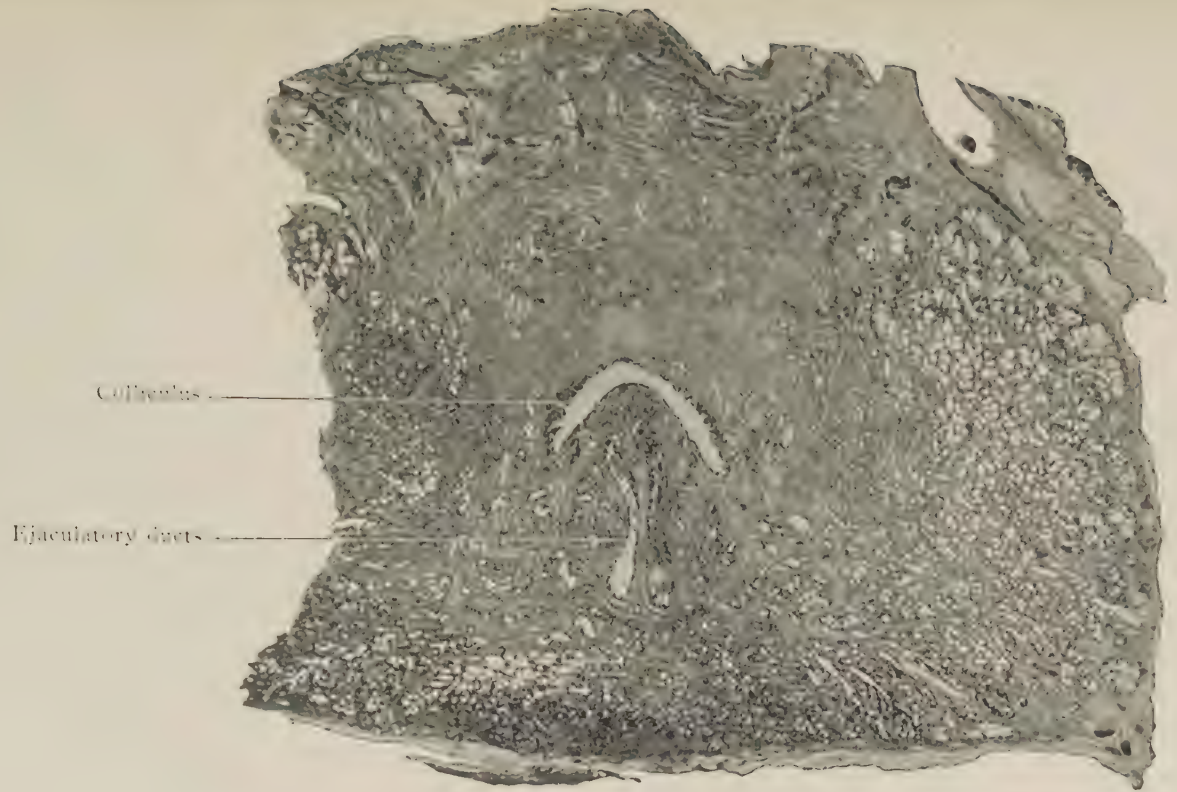

Fig. 65.—Section of prostate and urethra, showing prostatic tubules, ejaculatory ducts, and colliculus. (Courtesy of *Dr. Hein,* Berlin.)

The cavity is the seat of chronic suppuration, and is prevented from healing by being filled with urine at each act of urination.

III. SUPPURATION OF THE ENTIRE PROSTATE.

This condition is always preceded by a parenchymatous prostatitis, but, instead of a spontaneous discharge of the small abscesses, several coalesce, form a large abscess, and destroy the entire lobe by a necrosis of the parenchyma.

The entire organ may be destroyed, so that it is converted into a pus-sac, whose wall is formed by a fibrous capsule.

Such large abscesses generally break in the urethra, but sometimes outward in the neighboring connective tissue.

COURSE.

The fever is continuous and high. The pain in the perineum and rectum is very severe, and radiates to the penis, loin, and hips.

The pain is increased by pressure, and sitting is impossible.

There is a constant feeling as though a foreign body, like a nut, were in the rectum, which causes expulsive efforts on the part of the muscles and occasions rectal tenesmus.

If the enlargement of the prostate is considerable it can be felt on examination, bulging into the rectum as a diffuse, ill-defined, doughy or fluctuating swelling.

The protrusion of the prostate into the rectum causes the stools to be flat or ribbon-shaped.

Urination is often extremely painful, and if the greater part of the enlargement is directed upward toward the urethra the prostate presses upon it and causes *complete retention* of urine.

The swelling and enlargement of the gland reaches its height about the seventh day, and may terminate in the absorption of the inflammatory products and resolution; or, if the abscesses are small, they may discharge into the urethra and their walls undergo cicatrization.

In the cases which undergo *resolution* there is a gradual improvement in the symptoms. On the other hand, if *suppuration* takes place, an abscess forms in the center of the gland, and the formation of pus is announced by a throbbing pain in the perineum and chills, followed by fever and sweating. If operative measures are not resorted to, the pus bursts through the capsule of the prostate and the abscess empties itself into (*a*) the urethra, (*b*) the rectum, (*c*) or through the perineum, (*d*) or may take an eccentric course.

The pus has been known to burrow its way through the abdominal cavity and finally empty through the inguinal region, the umbilicus, the sciatic foramen, at the edge of the false ribs, through the space of Retzius, etc.

Segond reports 102 cases of parenchymatous prostatitis which ruptured as follows:—

35 times in the urethra,
28 times spontaneously,
7 times after passing catheter.
18 times into rectum alone.
21 times into urethra and rectum.
28 times in various regions.

In favorable cases the fistulous opening may close by granulation, but feces, urine, or pyogenic germs may easily enter the fistula, and urinary infiltration, septic infection, and pyemia are not infrequent results. A perforation in the rectum or urethra may leave a permanent fistulous opening, with its attendant annoyances.

Parenchymatous prostatitis is a disease which is dangerous to life itself.

Segond's statistics of 114 cases show: 70 recoveries, 34 deaths, 10 persisting fistulæ.

DIAGNOSIS.

Parenchymatous prostatitis may readily be overlooked, and the case regarded as one of posterior urethritis, which is always present and has similar symptoms, *unless rectal examination is made,* by which the enlargement of the prostate can be easily felt.

The prostate feels large, tense, and very painful. After a considerable portion of the gland has suppurated, a sense of fluctuation is usually perceived, but pus is present long before it can be detected by the examining finger.

A significant symptom of prostatic abscess, according to Alexander, is the *occurrence of a large amount of albumin in the urine,* entirely out of proportion to the amount of pus or blood present, and without existing renal disease, which disappears promptly on opening the abscess.[1]

The probable explanation is that, on account of the pressure on the veins, the blood-serum is squeezed out into the posterior urethra and flows back into the bladder.

[1] Medical News, May 31, 1902.

TREATMENT.

The indications are:—

I. To lessen the severity of the posterior urethritis.

II. To prevent suppuration of the prostate.

III. If pus forms, to evacuate it promptly by incision.

The patient is put to bed, sandal-wood oil is administered, and the pain and tenesmus controlled by opium. Locally either an ice-bag or hot poultices are applied to the perineum, a safe guide for the choice between hot and cold applications being the sensation of comfort afforded to the patient.

Hot sitz-baths, from one-half to one hour two or three times daily, are always called for.

Continuous irrigation of the rectum with hot water, for half an hour at a time, by means of Kemp's tube is often useful, or Frank's rectal tube may be used instead. The instrument is introduced into the rectum and six or eight quarts of water, as hot as can be borne, are allowed through it.

If retention of urine should occur, the catheter must be introduced, but only when absolutely necessary, and, before catheterizing, the urethra should be well irrigated to free it from pus, which might be pushed ahead of the catheter into the bladder.

If great difficulty is experienced in introducing the catheter, it is proper to anesthetize the patient with ether and leave the catheter tied in the bladder, to obviate the difficulty of reintroduction. In extreme cases aspiration of the bladder above the pubes may be demanded.

In all cases in which the symptoms do not improve within the *first week,* but, on the contrary, the fever continues, the local symptoms grow worse, and rectal examination shows an increase in the size of the inflamed prostate, one can be sure that *abscess* is forming.

This serves as an *urgent indication* to give vent to the pus and allow it to discharge; for if the pus is allowed to burst through the capsule of the prostate spontaneously, it may burrow through the tissues and cause urinary infiltration and pyemia, or at least a fistula, which does not heal without operation.

For this reason surgical measures should be resorted to.

VARIETIES OF OPERATION.

I. *Dittel's Operation.*—This was formerly the classical procedure and was, until recently, generally performed.

Technique of Operation.—The patient is anesthetized and a sound introduced through the urethra into the bladder. A semilunar incision is made through the skin of the perineum, curving around the rectum in

order to avoid wounding it. The incision is deepened by dissection until the capsule of the gland is reached and opened and the pus evacuated. The wound is packed and allowed to heal by granulation.

This operation gives free access to the prostate and permits the ready evacuation of the pus, but it has certain disadvantages.

The wound is very extensive and takes a long time to heal, and from the proximity of the rectum below and the urethra above it is certain to be infected.

II. Another operation, suggested by Alexander, Fuller, and others, commends itself on the ground of simplicity, and also because the incision is in the line of the course which the pus takes when spontaneously evacuated.

Technique.—An external urethrotomy is done on a grooved staff, and the posterior urethra dilated with the finger. The collection of pus in the prostate is easily felt and the pus evacuated by tearing through the mucous membrane of the posterior urethra and opening up the abscess cavity with the right finger. The prostate should be held steadily by means of the left forefinger in the rectum.

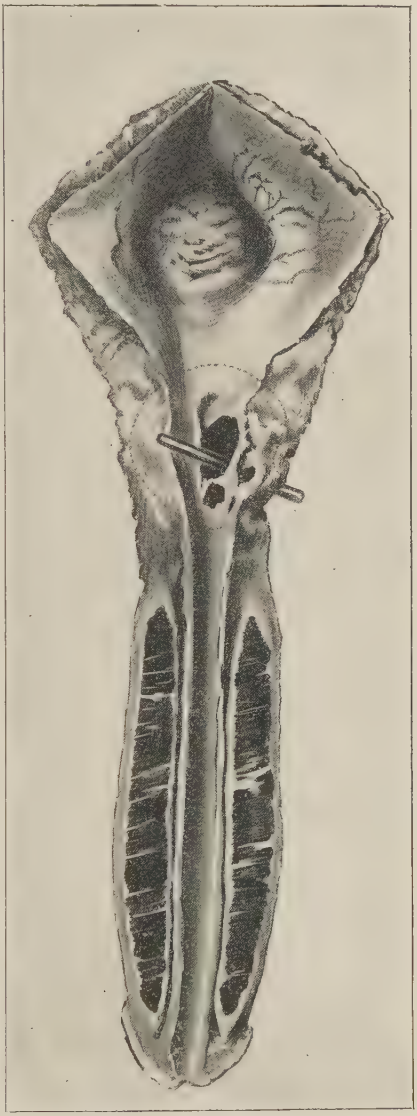

Fig. 66.—Abscess of prostate ruptured into urethra.

The bladder is subsequently drained with a large soft-rubber catheter for several days.

The patient is allowed to get out of bed in a week, and at the end of the second week is able to pass all his urine through the urethra. If a pus collection is not found, Fuller advises a simple division of the prostate into two halves along the floor of the urethra and the bladder.

If pus forms later, it is thus afforded a means of escape and the bladder is drained for ten days with a tube.

III. Another procedure which is only applicable to those cases where operation has been delayed and the abscess is seen obviously pointing in the perineum, is, with the finger in the rectum as a guide, to thrust a narrow straight bistoury directly into the fluctuating mass, through the skin of the perineum, and evacuate the pus.

When spontaneous rupture of a prostatic abscess has occurred, and one or more fistulæ exist, they usually communicate with the bladder and are kept from healing by the urine flowing through them. These fistulous tracks can only be cured by preventing the leakage of urine by means of an external urethrotomy and bladder drainage, at the same time laying open, or at least curetting, the suppurating sinuses.

The above remarks apply particularly to the treatment of cases where a large area is involved in the suppurative process.

When a very limited area of suppuration in the prostrate is present, involving perhaps two or three of the prostatic tubules, the temperature is only slightly elevated and the local symptoms are not marked.

After two or three days the temperature becomes normal and the tenesmus and frequent urination disappear.

In such cases an incision into the prostate is not required, for the minute abscess generally ruptures into the urethra and the sinus fills in by granulation.

Wossidlo advises beginning regular massage of the prostate two or three times a week, followed by irrigation as soon as the abscess has discharged its contents into the urethra.

In this way it is possible to press out the pus, keeping the abscess cavity empty and allowing it to heal.

CHRONIC PROSTATITIS.

Chronic prostatitis is perhaps the most important complication of gonorrhea, for the reason that the gonococcus, with all its infectious qualities unimpaired, may be retained for years in the diseased tubular glands of the prostate without its presence being suspected.

Probably most of the cases where wives are infected with gonorrhea by their husbands come from an uncured prostatitis.

Chronic prostatitis is also of moment on account of the profound disturbance to the general nervous system, and impairment of the sexual function, which it usually occasions.

In almost every case of chronic gonorrheal urethritis the prostate is found to be involved.

Chronic prostatitis frequently originates as an attack of acute catarrhal prostatitis, which becomes chronic; or it may be the result of a slow, insidious extension through the prostatic ducts of an inflammation from the posterior urethra. In the latter case the posterior urethritis was not of necessity due to gonorrhea, but may have originated as a result of sexual excesses or abuses, such as masturbation, "withdrawal," etc.

The micro-organism causing the inflammation in the prostate depends upon the exciting cause. The gonococcus is responsible for many cases, but in the non-gonorrheal inflammations staphylococcus, streptococcus, colon bacillus, or active bacteria may be the infecting agent.

PATHOLOGICAL ANATOMY.

An opportunity has seldom been afforded for exact observations of the changes in chronic prostatitis. The findings in the few cases where autopsies have been made, notably by Fürbringer, are as follows:—

Gross Appearances.—The prostate is slightly enlarged, the seat of a diffuse swelling, or enlarged in certain parts. The cut surface appears of a pale, dirty-brown color, softer and juicier than normal, and infiltrated with indurated bands of connective tissue of an ivory whiteness.

Microscopic Appearances.—The *prostatic tubules* are stretched and changed into smaller or larger cystic cavities. Their walls are thickened from infiltration with round cells and swelling of the epithelium.

The *prostatic ducts* and *their mouths* are dilated and the seat of a round-celled infiltration, which stiffens them and keeps them open and gaping. The mouths of the ducts may be filled with small plugs of secretion, which are forced out by muscular contraction on urination, and appear floating in the urine as tadpole or comma-shaped bodies, under the name of *"Fürbringer's hooklets."*

In certain cases the mouths of the ducts are closed, so that the secretion does not run out.

The *cavities of the dilated tubules* are filled with a turbid, slimy fluid, composed of pus-cells, desquamated epithelium, and altered prostatic fluid; and gonococci are harbored at this point for an indefinite number of years. All the tubules of the gland may be more or less affected, or the changes may be limited to a few scattered groups of tubules in one or both lobes.

The *intertubular fibromuscular stroma* is infiltrated with broad, tough, ivory-white bands of connective tissue.

SYMPTOMS.

In many cases chronic prostatitis may exist without giving rise to any symptoms. Usually, however, a chronic posterior urethritis is

present and the symptoms will be caused by both conditions. (See Chronic Posterior Urethritis.)

The symptoms have been grouped by Young and Geraghty,[1] in a study of 358 cases, under three heads: (*a*) sexual; (*b*) urinary; (*c*) referred.

The sexual function is usually disturbed, and the patient complains of premature ejaculation on coitus, or frequent nocturnal emissions. He notices, at least, diminished sexual force, and frequently imperfect or absent erections.

Prostatorrhea occurs in a moderate number of instances, but by no means constantly, and is present in perhaps 15 per cent. of the cases, and is also a symptom of chronic posterior urethritis.

Prostatorrhea is the term given to the discharge, from the meatus, of a turbid, thick, sticky fluid of a brownish-yellow color, which generally occurs intermittently.

It is most frequent after stool and is then termed *defecation prostatorrhea;* and occurs more seldom at the end of urination, when it is spoken of as *micturition prostatorrhea.*

The discharge is accompanied by an unpleasant sensation in the deep urethra, and is followed by a feeling of weakness and exhaustion.

Prostatorrhea is due to the contractions of the muscles about the base of the bladder and rectum, pressing upon the prostate and squeezing out the contents of the prostatic tubules through their dilated and stiffened ducts. (See Chronic Posterior Urethritis.)

Prostatorrhea never occurs normally, and is important to differentiate from *other* urethral discharges.

The easiest of these to recognize is *"urethrorrhœa ex libidine."* This is the clear, transparent albuminous fluid emitted from every healthy urethra on sexual excitement and erection. The secretion is not derived from the prostate, but from Littré's glands and Morgagni's crypts in the urethra.

The discharge in *chronic gonorrhea* is purulent in appearance and contains numerous pus-cells, epithelium, gonococci, and other micro-organisms.

True *spermatorrhea* and *seminal emissions*, either sleeping or waking, are characterized by the presence of spermatozoa, while in prostatorrhea spermatozoa are absent.

In the cases of prostatitis caused by gonorrhea the character and quantity of the urethral discharge depend upon the stage of the urethritis. There may be a profuse purulent discharge, only a morning drop, or the urine may be perfectly clear. *Disturbances of urination* are generally present.

[1] Johns Hopkins Hospital Reports, vol. xiii, 1906.

Urination is generally frequent, and the demand is urgent, and pain or burning during the act is often noted. Sometimes the urination is slow and difficult, and spasmodic stricture may exist, causing the retention of more or less residual urine in the bladder.

Examination of the urine shows a diversity of changes. In many cases *"Fürbringer's hooks,"* which are plugs of secretion formed in the mouths of the prostatic ducts, are squeezed out by the muscular contractions and appear in the second glass of urine.

The urine may be perfectly clear, but if an active urethritis is present it will appear turbid from pus. Cystitis is not infrequently a complication, and bacteriuria is often observed. Phosphaturia is not uncommon, especially in the patients suffering from sexual neurasthenia, and rarely at the end of urination or after massage of the prostate; a discharge of grayish-white fluid consisting of lime salts mixed with mucus has been noted by Wossidlo and the author. *The referred symptoms* embrace a long category. Such patients complain of loss of energy, mental depression, and lack interest in all occupation or amusement. Their melancholy is so extreme that they sometimes have suicidal ideas, and are true sexual neurasthenics.

Pains are often referred to remote spots, and are felt in the suprapubic region, perineum, testicles, hips, buttocks, and elsewhere. Sometimes the pain simulates renal colic, and the accompanying blood and pus in the urine may make a diagnosis difficult.

COMPLICATIONS.

Smaller or larger abscesses may form in the diseased prostate and communicate with the urethra. After they have discharged the pus, their cavities fill with urine at each act of urination, and slowly and incompletely void their contents.

The patient suffers all the inconveniences of partial urinary incontinence, and the stinking pus from the cavity flows out incessantly and involuntarily from the urethra.

The prostate may subsequently become changed into a large cavity in which sounds and catheters are apt to catch.

Another danger which threatens a patient with chronic prostatitis is *tuberculosis* of the genital organs.

Its development is favored by the factors which tend to lower the local resisting power.

These consequences only occur in neglected cases which have continued for a long time.

DIAGNOSIS.

As the clinical history of chronic prostatitis, seminal vesiculitis, and chronic posterior urethritis is similar, we can only make a differential diagnosis by a careful examination of the patient.

The most important diagnostic measures consist in:—

I. Palpating the prostate per rectum.

II. The microscopic examination of the fluid which has been expressed from the prostate by digital pressure.

On **palpation of the prostate,** the whole organ may be found enlarged and tender, or the right or left lateral lobe may be involved alone. If a few scattered tubules are affected, shot-like nodulations will be noticed, distributed irregularly over the surface. In the latter stages, with the formation of fibrous tissue in the intertubular substance, the prostate is only slightly enlarged, but *hard.*

To distinguish between prostatitis and seminal vesiculitis is at times difficult, even for one with experience.

The seminal vesicles are often involved at the same time, and the entire mass, made up of enlarged prostate and swollen vesicles, imbedded in a mass of infiltrate, may be easily mistaken for an uncomplicated prostatitis.

If no perivesicular infiltration is present, the *sharp outline of the upper margin of the prostate* can easily be felt.

If perivesiculitis has occurred and the lower part of the vesicles is imbedded in an inflammatory exudate, the *upper margin of the prostate cannot be felt,* and the examining finger glides over the upper border and along the posterior surface of the vesicles without perceiving the furrow indicating the line of demarcation between the prostate and vesicles.

On palpation of the prostate, it is found that the secretion is more easily expressed than in the normal condition, and in this way we can obtain the material for the **microscopic examination of the prostatic fluid.**

This is obtained by massaging the prostate through the rectum and collecting the secretion on a glass slide as it drips from the meatus.

Instead of using a slide the **expression-urine test** may be employed by massaging the prostate through the rectum and so expressing or forcing out the contents of the prostatic tubules through their ducts into the urethra. The patient then urinates into a glass, and the stream of urine washes out the expressed prostatic contents into the glass.

On inspection, after massaging a normal prostate, the urine is seen to be milky, from admixture with prostatic fluid.

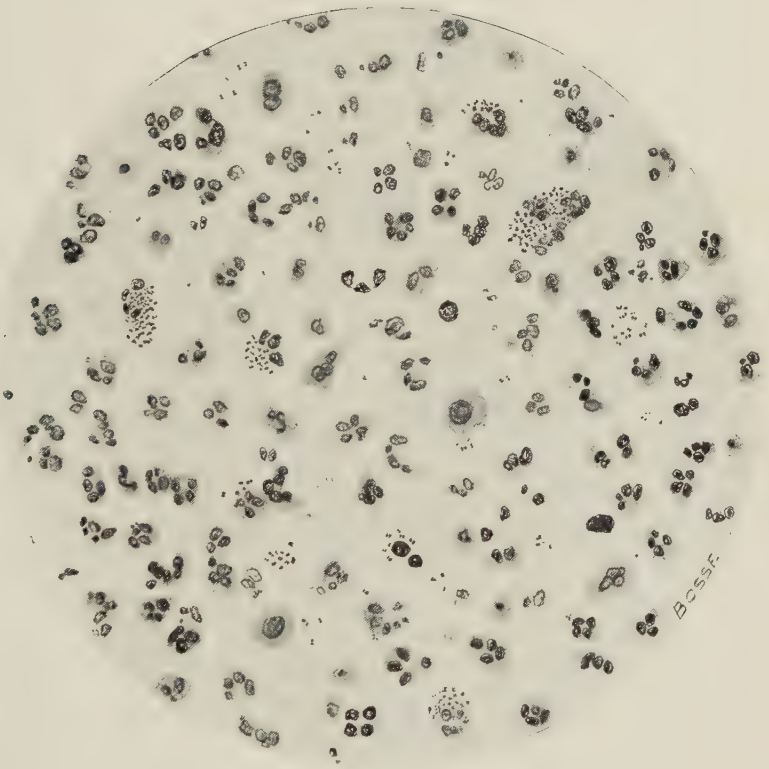

Fig. 67.—Secretion from chronic gonorrheal prostatitis, containing pus-cells and gonococci, extra- and intra- cellular. Original drawing from microscopic specimen.

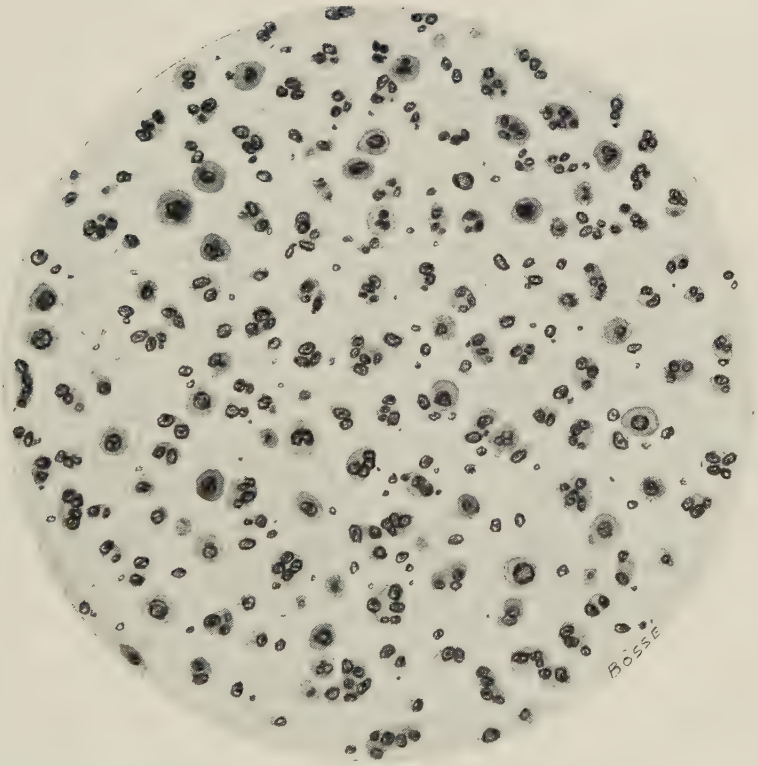

Fig. 68.—Secretion from chronic gonorrheal prostatitis. Large amount of pus; many mononuclear cells; no organisms. Original drawing from microscopic specimen.

If the prostate is diseased, flakes, chunks, and masses, formed of caked and thickened prostatic secretion, are generally noted, but sometimes the expression-urine only appears turbid from mixture with pus. Fürbringer's hooks from the prostatic glands are often present. By inspection alone of the secretion, whether it be collected on a slide or by the expression-urine test, we cannot form a correct opinion as to the healthy or diseased condition of the prostate, and it is necessary to resort to examination with the microscope.

MICROSCOPIC EXAMINATION.

If the prostate is the seat of acute or chronic inflammation, the microscope shows PUS-CELLS in greater or less numbers, and often gonococci. If no pus is present, prostatitis can be excluded.

In active cases pus-cells are very numerous, but as the patient improves the pus-cells diminish in number, many mononuclear cells make their appearance, and the lecithin bodies return.

In cases with much pus, gonococci are frequently, but not invariably, found even after several examinations, although they are present and growing in the deeper follicles of the prostate.

Because the gonococci are not found it by no means implies that they are not present, and for that reason a case of prostatitis can never be considered cured if any considerable number of pus-cells are present in the expressed secretion.

The normal prostatic fluid is found to contain many elements on microscopic examination. The findings are:—

I. *Lecithin bodies,* which are the most striking element in normal prostatic fluid. They are very numerous and appear as small, round, refractile bodies, and are chemically a glycerophosphate of neurin.

They are only found in prostatic secretion which is fairly free from pus, and one of the signs of restitution to health is a reappearance of the lecithin bodies.

II. *Mucus and granular phosphates,* with certain crystals, either *oxalate of lime, triple phosphates,* or *crystalline calcium phosphate.* If the urine is received immediately after being passed, the granular phosphates may be in the form of casts or clumps, but if it has stood for some time these break up and the phosphates are scattered throughout the urine.

III. *Epithelium* from the bladder, glands, and ducts of the prostate.

IV. *Amyloid Bodies.*—Authorities differ as to the frequency with which these are seen. They are generally absent in young and middle-aged subjects, but occur more frequently in elderly men. When present they are seen to have a concentric arrangement and are formed from

the secretion of the prostatic cells and broken-down cells. Later they may become calcified and form prostatic concretions.

V. *Phosphatic concretions* are occasionally found, and in older subjects large hyaline cylinders, which are due to the inflammatory exudation which takes place in the gland tubules.

Many of the above findings are also present in seminal vesiculitis, but one element is absolutely characteristic of the prostatic secretion, as it is found nowhere else, and that is

Fig. 69.—Diagrammatic representation of prostatic secretion. Böttcher's crystals, amyloid bodies, pus-cells, and epithelium from prostatic ducts.

VI. *Böttcher's Crystals.*—These crystals are formed by adding a drop of 1 per cent. ammonium phosphate solution to the secretion expressed from the prostate.

The crystals are distinguished by their dagger shape and the beautiful forms which they assume upon crystallization, and their base is found nowhere but in the prostatic fluid. In order to find them it is necessary to examine the prostatic secretion without mixture with urine, as the urine interferes with the crystallization.

The unmixed prostatic fluid can be obtained by collecting on a cover-glass some of the fluid which escapes from the meatus after massage of the prostate.

VII. *Spermatozoa.*—These are not found in cases of uncomplicated chronic prostatitis, but, as it is almost impossible to massage the prostate without at the same time expressing some of the contents of the vesicles, spermatozoa are generally found.

VIII. If the prostate is the seat of acute or chronic inflammation, *pus-cells* are always found, and from a clinical standpoint the pus-cells are the important elements to look for, as, if no pus is present, prostatitis is at once excluded.

In considering the question of marriage for an individual who has had prostatitis, the permission should not be given *if pus is present,* even though no gonococci may be found.

For while gonococci are easily found in the expressed pus when abundant, a few may still exist in the prostatic tubes, with all their infectious qualities, which may be overlooked on microscopic examination.

On examining a case of chronic prostatitis with the urethroscope a chronic inflammation of the posterior urethra is found to be nearly always present.

The mucous membrane of the posterior urethra is purplish red, swollen, and congested. The colliculus is greatly enlarged, so that it stands up at the end of the endoscopic tube like a half-ball and bleeds freely.

BACTERIOLOGY OF THE PROSTATIC SECRETION.

The point of supreme importance, however, in the matter of permitting marriage or coitus is whether the inflammation in the prostate was caused by the gonococcus, and if it be still present, or whether the infectious agent was some other organism.

There is a great diversity in the reports of the different investigators, depending upon the length of time after infection when the examinations were made.

It is certainly a fact that in some cases the gonococcus may disappear spontaneously after some months, but an infection with other organisms, staphylococcus, streptococcus, or colon bacillus, occurs to prolong the inflammation. Von Notthaft, after examining 120 patients, found gonococci in the prostatic secretion as follows: 73 per cent. in the second half-year after infection; 50 per cent. in the third half-year; 18 per cent. in the fourth half-year, and 6 per cent. in the third year. From the end of the third year gonococci were no longer to be found, while in the second half-year other organisms made their appearance.

De Santos Saxe[1] examined 108 cases of prostatitis and found 28.7

[1] N. Y. Med. Jour., Oct. 2, 1909.

per cent. in the prostatic secretion. After three years gonococci were found rarely, even after most persistent efforts. Mixed infection occurred in 86 per cent. of the cases studied; the older the case, the more prevalent was the mixed infection. Staphylococci occurred in 74 per cent., bacilli in 28 per cent., Gram-positive diplococci in 10 per cent., and streptococci in 7.6 per cent., of cases with mixed infection.

Wolbarst[1] reports several cases in which the gonococci persisted for more than three years: ten years in one case and eighteen years in another.

CULTURES.

On account of the difficulty of finding the gonococcus microscopically several years after infection, attempts have been made to cultivate the organisms from the prostatic secretion. By this means other organisms can be readily cultivated and identified, but the gonococcus oftentimes will not grow, even when hydrocele-agar, which is the favorite medium, is used, and this is especially true of the cases of long standing; so that for a practical test as to their presence a negative culture does not necessarily mean the absence of gonococci.

PROVOCATIVE INSTILLATIONS.

After several examinations of the expressed prostatic secretion without finding gonococci, an instillation of nitrate of silver, gr. v to the ounce, into the posterior urethra, followed in twenty-four hours by prostatic massage, will often bring out the gonococci so that they can be found microscopically.

PROGNOSIS.

The prognosis of chronic prostatitis is on the whole not unfavorable, but improvement is slow and treatment must be continued for a long time. The mental symptoms are often materially improved after a short time under treatment, and the progress of the case toward recovery can be controlled by palpation of the prostate and microscopic examination of the secretion.

Relapses are apt to occur, from a lighting up of the catarrhal inflammation, and must be treated by suspending all local treatment by massage and relying on irrigations of nitrate of silver in the urethra.

TREATMENT.

It is important, in the treatment of these cases, to secure the confidence of the patient and encourage him by explaining that his condition is one which can be cured, and that he is not impotent nor likely to become so,

[1] Med. Rec., Aug. 21, 1909.

and that the mental disturbances of which he complains are due to a purely local condition which is not dangerous. At the same time he should be informed that the treatment calls for great patience on the part of both physician and patient and may extend over several months.

The first indication for treatment is to improve the general condition of the patient by means of diet and exercise in the open air.

Constipation is generally a prominent symptom, and it is necessary to regulate the bowels, using saline cathartics for their depleting action on the pelvic organs, which has some effect in relieving the congestion of the prostate.

All sorts of erotic excitement should be strongly interdicted on account of their effect in inducing congestion of the prostate. Coitus should not be permitted because of the danger of infecting the woman.

Under the head of local treatment we can speak of measures which have a more direct action upon the prostate.

The most useful means of affecting the prostate itself is **massage through the rectum,** and we can in this way express the contents of the tubular glands.

The advantage comes from periodically emptying the dilated prostatic tubules of their retained and thickened secretion. There is also an improvement in the blood-circulation, which causes absorption of the inflammatory products and strengthens the relaxed muscular fibers.[1]

The massage should be performed twice or three times a week.

In order to lessen the danger of epididymitis Frank advises irrigating the urethra and filling the bladder before massaging the prostate. After the massage the patient empties the bladder.

In this way the urethra is cleansed first, and any infectious material which had been expressed from the prostatic tubules is washed away afterward.

It is supposed that the massage causes an alternate opening and shutting of the mouths of the ejaculatory ducts, which exert a suction, and

[1] The author has often noted that in certain cases, on beginning the treatment by massage, there would be no immediate improvement.

After massaging a number of times the prostate, which was originally *hard,* begins to feel soft, and at each massage a larger amount of pus was expressed than on beginning treatment.

When softening and increased discharge once begin, the enlargement of the prostate disappears with great rapidity, sometimes in one week.

The probable explanation is that the ducts of the dilated tubules are closed, and that the massage forces out the plug, and also presses out the accumulation of pus in the dilated tubule, and the prostate collapses after being emptied.

In other cases a dram of prostatic fluid mixed with pus may be expressed at the first massage, and the quantity diminishes at subsequent sittings till only a few drops are squeezed out.

These patients often require only a few applications of the massage before they are entirely cured.

cause material in the urethra to be drawn into them, descend through the vas deferens, and cause epididymitis.

Since adopting this suggestion in his office and clinic, epididymitis following prostatic massage is a rare accident in the author's practice.

The solutions used before massaging the prostate are albargin, 1 : 1000, if gonococci are present; oxycyanide of mercury, 1 : 4000, or nitrate of silver, 1 : 4000, if there are no gonococci.

Not all patients are suited to massage of the prostate, and, as long as irritative symptoms such as nocturnal emissions and painful erections are present, the massage is apt to be badly borne.

The question as to how long to continue the massage is a very important one, for it sometimes happens that by continuing it too long the neurasthenia is made worse. As a practical rule it may be stated that

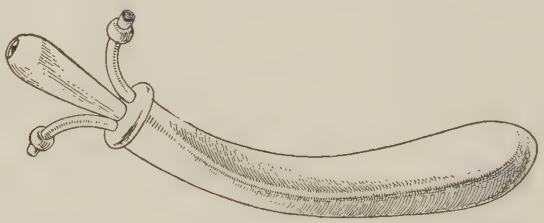

Fig. 70.—Arzberg's rectal psychrophore.

the massage may be continued as long as the symptoms are improving and the pus in the prostatic secretion is growing less, but after six or eight weeks' continuous treatment the improvement ceases and the case is at a standstill.

At this point it is better to stop all treatment for one month. Not infrequently after a month's rest the pus will be found to have disappeared. If pus is still present, another course of massage is indicated, but in a few cases it is impossible to rid the prostate entirely of pus.

In those cases, Albarran, Young, and Zuckerkandl have performed perineal prostatectomy, but there is always the danger of impotence or sterility to be considered after such an operation.

Before resorting to such a serious and doubtful procedure the patient should be advised to try the effects of a long vacation spent out of doors; a couple of months camping in the woods or at sea will relieve the neurasthenia, and the *vis medicatrix naturæ* will most likely clear up the prostatic suppuration.

As an adjuvant to the massage, heat in the rectum applied by means of *Arzberg's rectal psychrophore* is always useful. The instrument is

inserted in the rectum and lies against the prostate, and a continuous stream of hot water is allowed to flow through it once a day.

In some obstinate cases the *gonococcus vaccine* injected subcutaneously has seemed to exert a beneficial effect.

As most cases of prostatitis suffer from **chronic posterior urethritis,** it is important not to overlook this condition, but to treat it as well.

If there is a great deal of catarrhal inflammation, with much pus formation, irrigations are in order; but if the suppuration is only slight, *instillations* with an Ultzmann syringe are indicated.

In light cases 5 or 10 grains to the ounce of nitrate of silver may be used, but in old and obstinate cases stronger solutions are called for, and the strength may be gradually increased to 25 grains to the ounce.

Strong solutions can be better applied through the **endoscope.**

In nearly every case of chronic prostatitis the verumontanum is markedly diseased and requires particular attention.

The best method of treating it is to apply a strong solution of nitrate of silver, 100 grains to the ounce, directly upon it through the urethroscope.

Some reaction follows these applications, the discharge increases, and the patient has frequent urination, often followed by bleeding.

After eight or ten days it is safe to make another application.

Tincture of iodine may be used if the nitrate of silver causes too much pain.

After half a dozen strong applications, the verumontanum will be found to be in the normal condition again; but if the chronic posterior urethritis accompanying the prostatitis has existed long, a submucous infiltration will have occurred, which also demands treatment by **dilatations with the Kollmann-Frank irrigating posterior dilator.**

The indication for beginning dilatations, as stated by Frank, is after the massage has been continued for some time and the prostate feels normal, but the patient still has symptoms of neurasthenia, and the microscope shows a small amount of pus in the expressed prostatic secretion.

After the local conditions in the prostate and posterior urethra have been cured, the neurasthenia generally disappears. When, however, it persists, *faradism,* with one pole in the urethra and the other in the rectum, is often beneficial. (See Posterior Urethritis.)

DISEASES OF THE SEMINAL VESICLES.

CHAPTER VIII.

ACUTE SEMINAL VESICULITIS.

Acute inflammations of the seminal vesicles are generally due to gonorrhea, although a chronic inflammation may originate from other causes.

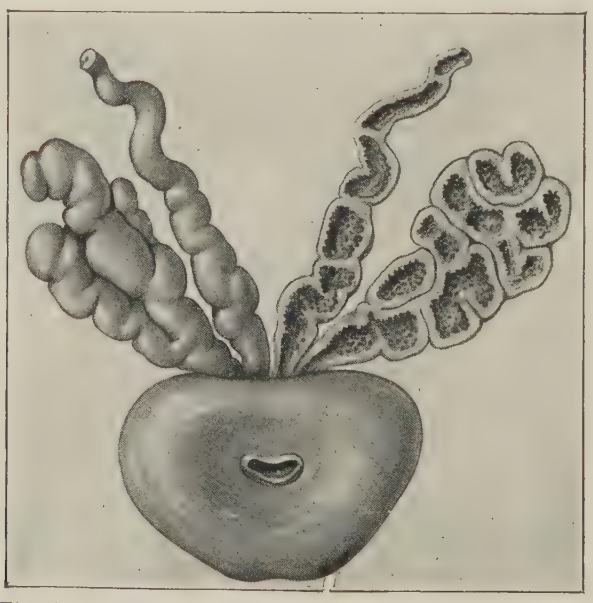

Fig. 71.—Prostate and seminal vesicles. Left vesicle laid open to show structure.

A gonorrheal inflammation of the interior of the cavity of the vesicle is excited when the gonococci pass from the posterior urethra through the ejaculatory ducts, and are deposited within the vesicle.

Its walls secrete pus and its cavity soon becomes filled up and distended with a purulent accumulation.

SYMPTOMS.

The symptoms are not very characteristic, and are merely those of the posterior urethritis, which, of course, is always present. Fever and

a throbbing pain in the vesicles and tenderness in the suprapubic region are always observed.

Seminal discharges which are *red* or *chocolate colored* from the admixture with blood often occur. The blood may be derived from the cavity of the vesicle itself or may be acquired by the semen, from a congested posterior urethra, as it passes through it.

If the posterior urethritis is cured, the urine is clear at first, but later in the disease the vesicles pour out their purulent contents into the

Fig. 72.—Microscopic examination of material expressed from seminal vesicles and prostate, showing spermatozoa, pus-cells, and Böttcher's crystals.

posterior urethra, and the pus flows back into the bladder, discoloring the urine when it is passed.

DIAGNOSIS.

The diagnosis of seminal vesiculitis can only be made by *rectal examination,* and the vesicles can be felt swollen, soft, fluctuating, and intensely tender.

Epididymitis is a most frequent result of vesiculitis, and is brought about by some of the gonococci-laden pus-cells being carried through the vas deferens and deposited in the epididymis.

Peritonitis, which sometimes becomes general, may occur from the close relation which the peritoneum bears to the vesicles.

TREATMENT.

The treatment of acute vesiculitis is chiefly expectant, and consists in putting the patient to bed and giving a saline cathartic, which is always in order in every pelvic inflammation.

Fig. 73.—Ampulla of vas and seminal vesicle. Low power.

Hot sitz-baths and copious irrigations of the rectum with hot water are useful in allaying the inflammation.

If the posterior urethritis is severe, sandal-wood oil relieves the tenesmus and renders the urine less irritating.

Injections into the anterior urethra, of course, are contraindicated, but above all things any attempt at massage or stripping the vesicles should be absolutely interdicted.

Under this plan of treatment most cases of acute vesiculitis will get well in from two to four weeks' time; but when resolution does not occur the disease passes into the chronic state.

Fig. 74.—Ampulla of seminal vesicle.

CHRONIC SEMINAL VESICULITIS.

The condition of chronic inflammation of the seminal vesicles was but little understood until the publication of Eugene Fuller's first paper upon this subject in 1893. Chronic vesiculitis may originate from an *acute* attack of vesiculitis which does not undergo resolution; but, as a rule, it develops insidiously, as the result of the extension of a

chronic inflammatory process which begins in the posterior urethra and extends through the ejaculatory duct. The ejaculatory duct is never compressed by the changes, but throughout the whole course of the disease it remains patulous, and sterility does not occur.

According to the classification devised by Fuller, chronic seminal vesiculitis presents itself in *two varieties*:—

Fig. 75.—Cross-section of normal seminal vesicle.

I. **Atonic vesiculitis,** in which there is only an atony of the muscular fibers composing the walls of the vesicle.

II. **Inflammatory vesiculitis,** in which the walls of the vesicles are thickened and indurated as a result of inflammation, which may be simple, gonorrheal, or tubercular in origin.

Either form of vesiculitis may exist by itself; but, as a rule, there is a combination of atony and inflammation of the vesicular walls.

Atonic Vesiculitis.

This form of vesiculitis may be induced by a previous attack of acute inflammation in the organ, which does not undergo complete resolution. It is more liable, however, to be provoked by some form of sexual abuse, which consists in a frequent repetition of the sexual act. In consequence the muscular fibers become exhausted, lose their tone, and the walls of the vesicles become thinned, atonied, and stretched. The cavities become distended with seminal fluid, because the weakened

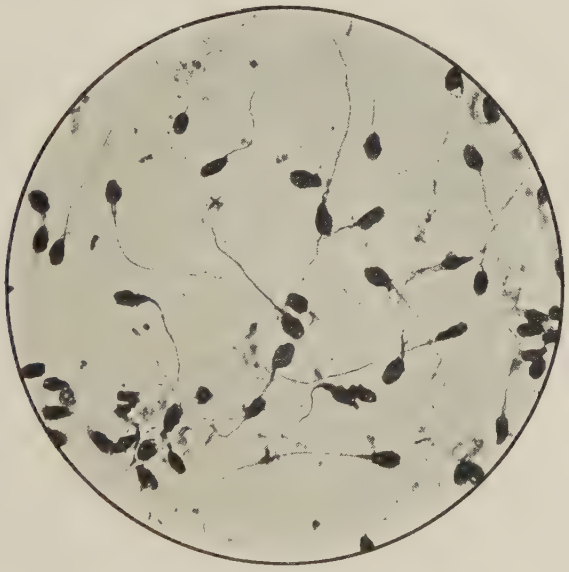

Fig. 76.—Spermatozoa obtained by massaging healthy seminal vesicles.

muscular fibers are no longer able to evacuate the contents, and the secretion becomes thick and inspissated.

The vesicles are distended and enlarged, and feel like a swollen leech to the examining finger.

On stripping the vesicles the expressed seminal fluid appears abnormal.

The *expression-urine* is not clear or slightly milky in color as it should be, but the expressed contents of the vesicles appear in the glass of urine as *coagulated masses* of *gelatinous material,* which often resemble casts half an inch long and as thick as a knitting-needle. These masses are the jellified contents of the vesicle, molded by the ejaculatory ducts as they are squeezed through them. Microscopically they are

found to consist of a sort of thickened wall identical with the rest of the body itself, in which are imbedded innumerable spermatozoa. The bodies also contain epithelium from the vesicles, and in cases of disease of the vesicles pus-cells with or without gonococci.

The other form in which the inspissated semen is found resembles sago-like globules floating in the urine from the size of a barleycorn to a lentil. Under the microscope these are found to be composed of an albuminous material containing large numbers of spermatozoa.

Smaller bodies, resembling melting sugar or frogs' spawn, averaging the size of a pinhead, are often present in considerable numbers, disappearing soon after being passed in the urine. Microscopically they are structureless, consisting only of a homogeneous matrix.

In addition to these, delicate, yellowish-white, skin-like fragments are often found, which are probably composed of bits of inspissated secretion which has lain a long time in the vesicles, perhaps between the closely lying folds of a collapsed portion.

The above findings do not denote a diseased condition, but only a hypersecretion and a certain physiological amount of stagnation of secretion due partly to retention, and partly to the absorption of the fluid portion of the vesicular contents (De Santos Saxe).

After a time the atonic vesicle almost invariably becomes infected by some germ, often the bacillus coli from the rectum, and inflammatory changes are induced.

For practical purposes it is only necessary to consider two forms of chronic inflammation of the vesicle:—

(*a*) **Chronic inflammation without perivesiculitis.**

(*b*) **Chronic inflammation with perivesiculitis.**

When *perivesiculitis is absent,* there is no inflammatory infiltration or hyperplasia of the connective tissue surrounding the vesicles. The vesicle is large, and its walls are thinned and atonied, but they are hardened and sclerosed by fibrous changes, as a result of the inflammation which always occurs in this form within the walls.

A mucopurulent secretion may be abundant and accumulate within the cavity of the vesicle. Granulations often form within the cavity, causing hemorrhage.

The entire vesicle may be filled with a blood-clot, or, if the bleeding is slight, the seminal discharges may be stained brown or chocolate color.

When *perivesiculitis is present,* a small round-celled infiltration is thrown out in the early stages, surrounding and imbedding the vesicles. In time the infiltration becomes organized with fibrous connective tissue, which forms adhesions, binding the vesicles down to the base of the bladder. The entire mass, composed of vesicles imbedded in fibrous

tissue, appears like a part of the prostate, and may easily be mistaken for it, on rectal examination.

After the fibrous tissue has existed for a little time, it begins to contract and in consequence the vesicles are pressed upon and squeezed together so that they become smaller than normal.

The ejaculatory duct is never compressed by these changes, but always remains open; consequently there is no sterility.

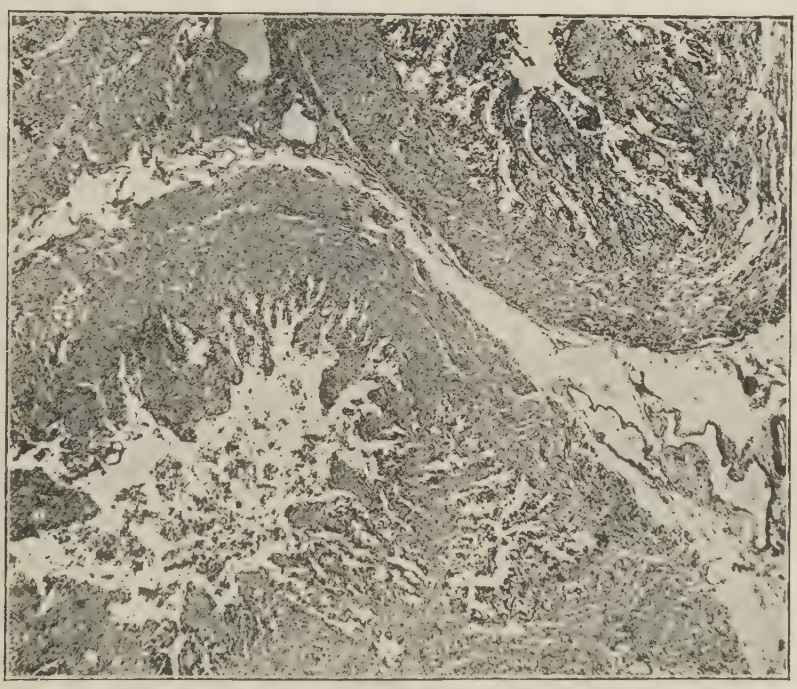

Fig. 77.—Purulent spermatocystitis.

ETIOLOGY.

As to the etiology of the inflammatory forms of vesiculitis, gonorrheal infection is a very frequent cause.

Chronic vesiculitis may originate from an *acute* attack of vesiculitis; but it is more frequently due to a *gonorrheal* inflammation of the posterior urethra, which extends along the ejaculatory duct and attacks the walls of the vesicle and often the perivesicular connective tissue.

Other causes besides gonorrhea may induce chronic inflammatory changes in and around the vesical walls.

A *non-specific vesiculitis,* so called to distinguish it from the gonorrheal, or specific, form, may arise *within* the cavity of the vesicle itself, as a result of an atonic condition of the vesicle.

Again, a low grade of chronic inflammation of the **posterior** urethra may be established as a result of sexual excesses, masturbation, etc., which spreads along the ejaculatory duct and attacks the vesical wall.

Finally, with old men who are beginning catheter life the traumatism often excites a subacute inflammation of the vesicles, which extends to the epididymis.

SYMPTOMS.

The symptoms of both gonorrheal and simple vesiculitis depend chiefly upon the accompanying posterior urethritis, and consist in frequent urination and spasm or irritability of the cut-off muscle. On straining at stool a glairy, sticky discharge escapes from the meatus, which is the secretion expressed from the dilated and patulous ejaculatory ducts and is termed *spermatorrhea.*

The *mental symptoms* are always very prominent, and the individual suffers from depression of spirits and malancholy, irritability of temper, and quarrelsomeness. Hypochondria is notably marked, and patients are alarmed over ridiculous trifles. They complain of the penis being shriveled, cold, or numb; that the testicles are retracted or that one hangs lower than the other, and suppose that the testicles are beginning to atrophy and they are growing impotent. In their alarm they consult some of the advertising quacks, who prey upon their fears and deluded ignorance.

Another important group of symptoms is connected with the *sexual function.* In the early stages there is an increase in the sexual desire, with frequent nocturnal emissions and premature ejaculation on coitus. The seminal discharges are often mixed with blood, which may be acquired from the posterior urethra or the cavity of the vesicles. As the case progresses, erections cease, the sexual desire is lost, and at last a condition of true impotence is established.

DIAGNOSIS.

The clinical history of these cases is generally significant of involvement of the vesicles, in the gonorrheal form. The patient complains of a gonorrheal discharge, which lasts, with intermissions, for years. Any slight indiscretion brings on an exacerbation, which is often mistaken for a fresh attack of gonorrhea. The discharge lasts for a few days and then subsides, until another indiscretion lights it up again.

The diagnosis can only be made by **rectal examination,** and in order to determine the condition of the vesicles a very considerable amount of practice is necessary in order to attain the necessary *tactus eruditus.* As the vesicles and prostate are continuous, without a line of demarcation, when the perivesiculitis is present, it is difficult for the

beginner to differentiate them, and, until one is experienced, a diagnosis of enlargement of the prostate is generally made, when the vesicles alone are enlarged and the prostate is normal in size.

Technique of Examination.—The patient, with his bladder moderately distended with urine, assumes the "leap-frog" attitude, bending over a chair and grasping the sides with his hands. The surgeon makes

Fig. 78.—*a*. Normal seminal vesicles and prostate. *b*. Chronic seminal vesiculitis without perivesicular infiltration—no involvement of prostate. *c*. Chronic seminal vesiculitis with perivesicular infiltration. Outline of vesicles indicated by dotted lines. White area surrounding them composed of infiltration. Prostate not affected. *d*. Prostate irregularly enlarged from chronic prostatitis. No involvement of vesicles.

counterpressure with one fist doubled up, pressing against the bladder, and the index finger of the other hand is inserted into the rectum. In order to get well up beyond the upper margin of the vesicle, it is necessary for the surgeon to support his right foot on a chair and by means of his knee make strong pressure against the elbow of his examining hand, in order to drive it well in.

If the vesicles are normal they feel soft, and the amount of distention depends on circumstances. If *atonic vesiculitis* is present, they feel large, distended, tense, and very painful. If *perivesiculitis* exists, they are hard, indurated, and brawny, feeling like a piece of pork, on account of the infiltration through the connective tissue, which surrounds the vesicles and forms adhesions which bind them down upon the bladder.

After examining the condition of the vesicles their contents should be stripped or expressed by the examining finger, beginning at the upper margin and squeezing or stroking in a downward direction, so as to press out the contents through the ejaculatory duct. The quantity of expressed material which runs out at the meatus varies from a few drops to half a dram or more. On examination the material is found to be thick and jellied or purulent.

The fluid expressed should be always examined microscopically. On examination with the microscope, *normal semen,* which is a mixed secretion from the prostate and vesicles, is found to be composed of large and small finely granular testicle-cells, some columnar and squamous epithelium, a few large, round hyaline bodies, lecithin corpuscles, amyloid bodies, a few leucocytes, spermatic crystals, and spermatozoa. In chronic seminal vesiculitis, *pus* is added to these findings and the spermatozoa are entirely absent or diminished in number, and either dead or of a very slight degree of motility.

As the patient's condition improves the spermatozoa reappear and also regain life and motility.

TREATMENT.

The treatment consists in stripping or expressing the contents of the vesicles once in from five to seven days. The effects of stripping are to empty the vesicles of their inspissated contents, without forcing the muscular fibers to contract, and eject the semen, and through the rest thus afforded them the muscles recover their tone. The inflammatory thickening around the vesicle is absorbed as a result of the massage.

Contraindications to stripping are: (*a*) the existence of an acute attack of vesiculitis; (*b*) blood in the expressed material, or (*c*) excessive tenderness. With these conditions present there is always danger of setting up an epididymitis.

The posterior urethra should not be overlooked, but should receive appropriate treatment, with irrigations or instillations or by the endoscope. It is desirable, however, not to use local treatment to the posterior urethra and strip the vesicles at the same sitting, but to allow

a couple of days to intervene. The duration of treatment is protracted, requiring from two to twelve months to effect a cure; but since Fuller's work upon the subject it is possible to cure cases which were beyond the reach of treatment before.

In the obstinate cases characterized by marked sexual neurasthenia or intractable gonorrheal rheumatism, Fuller advises free incision into and drainage of the seminal vesicles.

Fig. 79.—Showing the point of the director maintained at the apex of the right seminal vesicle, while the scalpel is passing along the groove preparatory to incising the organ.

Seminal Vesiculotomy.[1]—Fuller reports 224 cases operated upon without a death, and with relief of symptoms in 95 per cent. of the cases. He states that there is no loss of sexual power subsequently.

With the patient in the knee-chest position, two longitudinal cuts through the skin and fascia are made, opening up the ischiorectal fossæ. These are joined by a transverse incision just in front of the rectum.

With the left finger in the rectum as a guide, the rectal wall is separated from the prostate and vesicles by blunt dissection with the finger-tip of the other hand.

[1] Med. News, March 26, 1904; Jour. Amer. Med. Assoc., May 4, 1901; Med. Rec., Oct. 30, 1909.

After the separation is made a long grooved director is thrust through the tissues into the apex of the vesicle, using the finger in the rectum as a guide for the proper direction.

A scalpel is passed along the grooved director and the vesicle laid open for half an inch; the incision in the vesicle is then divulsed, with the finger-tip opening up widely the cavity of the sac.

The left vesicle is then opened in the same way. If granulations are found in the cavities they are curetted and packed with gauze and a rubber drainage tube placed between the gauze packing and the rectal wall on either side and the wound closed with sutures.

In the after-treatment no irrigation with the tubes is used; the gauze is removed on the fifth day and the drainage tubes on the ninth.

The bowels should be moved daily to guard against distention of the rectum with feces, and the patient kept in bed for two weeks.

The object of the operation is to provide free drainage for the cavities of the vesicles which are distended with pus, and so stop the absorption of toxins into the blood.

TUBERCULOUS VESICULITIS.

The seminal vesicles are usually involved by an infiltration with tuberculous nodules during the progress of a case of genitourinary tuberculosis.

The infection may extend from tuberculous deposits in the posterior urethra or prostate or may result in consequence of an extension of the disease from the epididymis along the vas deferens.

It is supposed that the involvement of the vesicles in the majority of cases is *secondary,* although J. W. White has noted that the vesicles often show evidences of infection weeks or months before the tuberculous process is evident in the corresponding epididymis.

A chronic or subacute inflammation of the vesicle, either gonorrheal or simple, is a strong predisposing element in allowing the tubercular process to become ingrafted upon these organs.

Uncomplicated tuberculous disease of the vesicles is never acute except in the presence of a mixed infection, either with the gonococcus or staphylococcus.

In this case an acute suppurative inflammation takes place within the cavity of the vesicle, which becomes filled and distended with pus.

Uncomplicated tuberculosis begins insidiously, and has a notable tendency to invade the surrounding tissues, and the process often becomes quiescent, although liable to take on renewed activity upon slight provocation.

A few cases, however, result in breaking down of the tuberculous nodules, with the formation of a perivesicular abscess, which discharges either through the rectum or perineum, leaving a fistula.

The symptoms of tuberculosis of the vesicle are not marked, and this condition exists unsuspected until a rectal examination is made, disclosing hard nodules in the walls and perivesicular connective tissue.

As both vesicles are infiltrated and thickened as well as the connective tissue around them, the mass is continuous with the prostate, and it is no easy task to distinguish these structures apart. In advanced cases the prostate is almost always the seat of tuberculous deposits as well.

TREATMENT.

The treatment consists in hygienic measures alone, of which the most important is an outdoor life in a suitable climate. Codliver oil and creosote are the drugs most in vogue.

Operative treatment is, in general, not required in acute suppurative inflammation caused by a mixed infection, when the accumulation of pus takes place *within* the cavity of the vesicle, as the pus drains out into the urethra, through the ejaculatory duct.

When, however, the *perivesicular* tissue infiltrated with tubercular nodules breaks down and forms an abscess, it is necessary to evacuate the pus. This may be accomplished through a free incision in the perineum, or, as Fuller and Routier prefer, by thrusting a director into the tumefaction, through the rectum, and divulsing the tissues until an opening large enough to admit the finger is obtained.

Extirpation of the vesicle has been attempted a few times for tuberculosis, but the results are far from satisfactory.

From the inaccessible location of the vesicles, an extensive incision is required to reach them, and the hemorrhage is difficult to control.

The bladder-walls and prostate are generally affected, and it is difficult or impossible to remove all the diseased material. The wound is slow in healing, and the confinement to bed exerts a bad influence upon the general condition of the patient; so that the tuberculous deposits, which are usually present elsewhere, advance in consequence.

STRICTURE OF THE URETHRA.

CHAPTER IX.

SPASMODIC STRICTURE.

Spasmodic stricture is a pure functional disturbance, without organic change, consisting in a spasm or cramp-like contraction of the cut-off muscle surrounding the membranous urethra.

CAUSES.

(*a*) *Located in the posterior urethra.* An abnormal irritability from excess in coitus or masturbation.

(*b*) *Located in the anterior urethra.* A granular patch or stricture. The introduction of a foreign body, such as a sound or bulbous bougie, or a piece of calculus, formed in the bladder and making its way through the urethra, and finally the reflex irritation caused by a narrow meatus.

(*c*) *Point of irritation not in the urethra, but remote from it,* as an operation about the anus, fissures or fistula of the anus, and entozoa in the rectum.

(*d*) *Various psychical influences,* such as shame or embarrassment.

The influence of these various points of irritation is carried through the nervous system and causes, as a reflex, a contraction of the cut-off muscle.

ORGANIC STRICTURE.

DEFINITION.

A deposit of newly formed fibrous connective tissues lying underneath the mucous membrane of the urethra and interfering with its dilatability. This fibrous tissue has a tendency to contract and produce a narrowing of the urethral caliber.

ETIOLOGY.

(*a*) *Inflammation,* which is generally due to gonorrhea, occasions an infiltration of small round cells which, if not absorbed, becomes organized into connective tissue.

(*b*) *Traumatism.*—A laceration or rupture of the urethra is healed by the process of cellular infiltration, which is thrown out to a consider-

able extent and subsequently becomes organized into connective tissue. Traumatic strictures are always notably dense and tough.

PATHOLOGY.

In gonorrhea, particularly the chronic form, the mucous membrane of the urethra becomes the seat of an infiltration with small round cells, which extends into the submucous connective tissue and finally involves the spongy tissue of the corpus cavernosum.

If the infiltration is *absorbed,* stricture does not form; but if absorption does not take place the infiltrating small round cells become trans-

Fig. 80.—Linear stricture.

formed into *spindle cells,* and these are ultimately converted into dense, retracting connective tissue (scar-tissue). The transformation goes on slowly, and it requires at least one or two years before the soft infiltration has become organized.

The following changes in the tissues result from the contraction of the new fibrous tissue:—

Morgagni's crypts and Littré's glands of the urethra, which were surrounded by the periglandular infiltration, have been obliterated by the contraction of the fibrous tissue.

If the corpus spongiosum was involved, its meshes are obliterated in the same way.

The caliber of the urethra is narrowed by the presence of a mass of firm, bloodless scar-tissue, composed of fibrillated connective-tissue cells lying underneath the mucous membrane and covered with many layers of squamous epithelial cells.

Desquamation of these squamous epithelial cells continues for years, forming light filaments, which float in the urine.

VARIETIES OF ORGANIC STRICTURE.

I. **Soft or recent stricture** is merely an infiltration of the tissues with inflammatory products, composed chiefly of small round cells.

II. **Cicatricial or inodular stricture** is a mass of new fibrous tissue which has been formed by the transformation of the soft infiltration

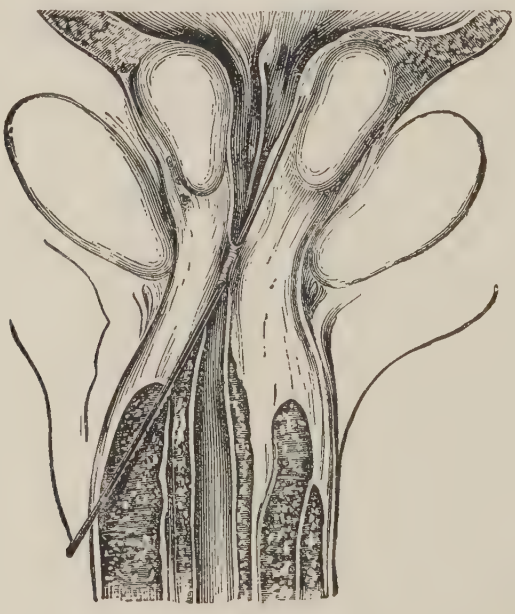

Fig. 81.—Annular stricture.

into true contractile connective tissue, and which, as it becomes older, grows tougher, denser, and more inelastic.

A stricture is described as *linear* when it consists of a fine band of fibers, *annular* when it is composed of a broader band encircling the urethra, and *tortuous* when it is made up of a heavy, irregular mass of tissue, producing a great deal of distortion and narrowing of the urethral canal.

NUMBER.

Traumatic stricture is always *single,* and occurs at the point of rupture in the canal.

Gonorrheal strictures are apt to be *multiple,* and it is usual to have two or even three present at the same time.

LOCATION.

Sir Henry Thompson examined 320 anatomical preparations of stricture and found that in 215 cases the bulbomembranous region was strictured and in 105 cases the stricture was in the first five inches of the canal.

The prostatic urethra is *never* strictured except as a result of traumatism, as inflammation here only produces a simple condensation and hardening of the submucous tissues, but does not narrow the caliber of the canal.

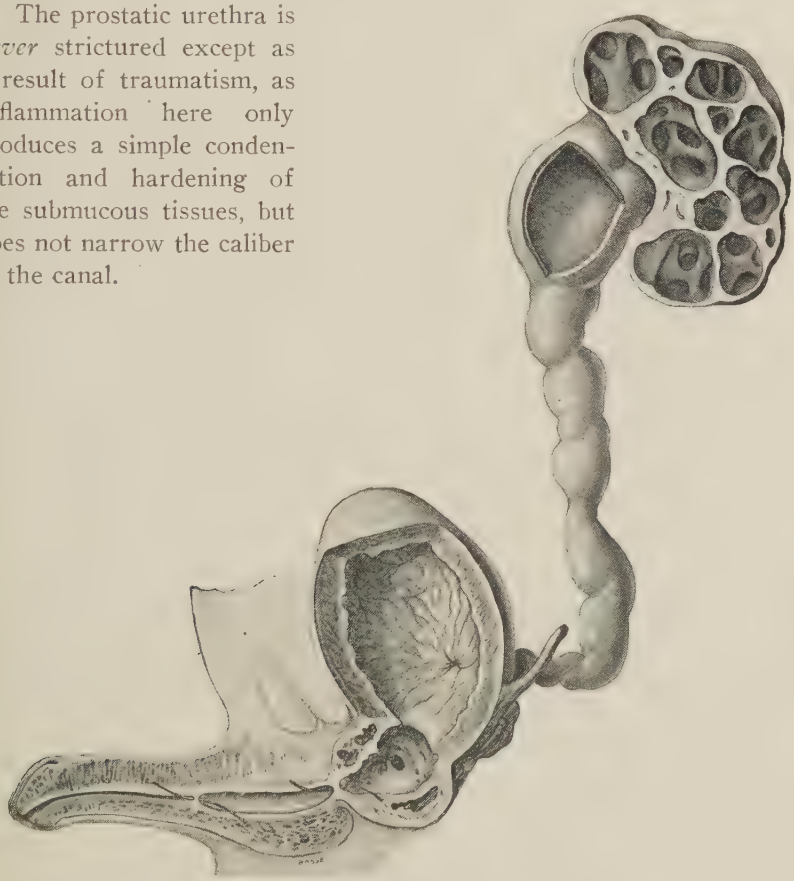

Fig. 82.—Changes behind a stricture. Dilatation of pouch behind the strictures. Hypertrophy and contraction of bladder. Dilatation of ureter and kidney. Hydronephrosis.

CHANGES WHICH TAKE PLACE BEHIND THE STRICTURE.

As a result of the obstruction to the free outflow of the urine, the urethra becomes enlarged and pouch-like, and a loss of its elasticity follows, from the frequent stretching which accompanies each act of urination.

This pouch retains a drop or two of urine, which decomposes, irritates the mucous membrane, and causes a chronic inflammation, with a gleety discharge.

The softened mucous membrane sometimes **ulcerates.** When a *small* ulceration occurs, a few drops of urine escape into the tissues and occasion a small abscess, which opens externally, forming a **urethral fistula,** or the urine may gain access to the tissues through the crypts and follicles which become dilated.

If a *large* ulceration takes place, a considerable quantity of urine escapes into the loose cellular tissue, and **extravasation** of **urine** results.

CHANGES IN BLADDER AND KIDNEYS.

The increased effort on the part of the bladder to overcome the resistance offered by the stricture causes a **hypertrophy of the bladder-wall.** The muscular bundles project into the cavity of the bladder and diminish its capacity, and contraction of the cavity occurs.

In exceptional cases the walls become thinned and atrophied, and *vesical atony* results.

RESIDUAL URINE.

Definition.—*The urine which remains in the bladder after the patient has endeavored to evacuate it completely.*

Residual urine exists in 93 per cent. of cases of stricture, and increases as the age of the patient advances. It results in cystitis, with vesical atony and damming back of the urine upon the kidneys.

The **ureters** and **kidneys** become distended and dilated from the backward pressure of the urine, as a result of the muscular contractions of the bladder during urination.

The medullary tissue of the kidneys is atrophied, and sac-like dilatations form (hydronephrosis). Pyelitis and abscess of the kidney occur as a result of infection with bacteria conveyed upward from the decomposing residual urine.

SYMPTOMS.

(*a*) **Frequent urination,** in the early stages depending upon a congestion of the posterior urethra and exaggerated irritability. Later in the course of the case, cystitis causes the desire to urinate frequently, and after the bladder has become atonied and full of residual urine the dribbling and incontinence, or overdistention, take place.

(*b*) **Dribbling after urination** results from some drops of urine, which are caught in the pouch behind the stricture, escaping a few minutes later.

(*c*) **Distorted or Smaller Stream.**—The patient requires a longer time to pass his water, and the stream is twisted or split.

(*d*) **Gleety discharge from the meatus,** composed of mucopus and shreds in the urine, is occasioned by the catarrhal inflammation of the mucous membrane *behind* the stricture, from the irritation of the decomposing urine.

(*e*) **Retention of urine** occurs at times suddenly and early from acute congestion of the mucous membrane at the strictured point, and is apt to be excited by exposure to cold or wet and alcoholic or sexual excesses.

Later in the progress of the case the retention is caused by the direct obstruction of the outflow of urine, arising from the slowly contracting stricture.

(*f*) **Pain in the urethra** is neuralgic in character and inconstant, and may never be felt.

Fig. 83.—Flexible bougie à boule.

(*g*) **Interference with Coitus.**—The erections are generally feeble, and premature ejaculation occurs from congestion and irritability of the posterior urethra, or the semen may be retained behind the stricture until the engorgement of erection subsides, when it oozes from the meatus.

DIAGNOSIS.

The examination of the urethra, as a rule, is not very painful, but in nervous individuals it may be injected with a 4 per cent. solution of novocaine.

For purposes of diagnosis the **steel sound** is too inexact, since, without disclosing any details, it will merely demonstrate that an obstruction exists in the urethra which prevents the sound from entering the bladder.

By means of the **flexible bulbous bougie** it is possible to feel the slightest pathological changes in the canal. As the bulb is introduced it glides along the urethra for six inches, until it fetches up against the cut-off muscle, and as it passes through the membranous urethra it is grasped by the muscle, but it feels freely movable again as soon as the posterior urethra is gained. When it reaches the sphincter of the

bladder it is slightly grasped again, but slips by and moves freely in the cavity of the bladder.

The same sensations of resistance and grasping are felt on withdrawing the bulb, and we should guard against the error of mistaking the resistance of the cut-off muscle for a stricture in the deep urethra.

As the bulb is moved the *healthy* mucous membrane of the urethra feels soft and velvety, but, when a stricture is impinged upon, a sensation of jolting is felt. There is a perceptible roughness of the walls of

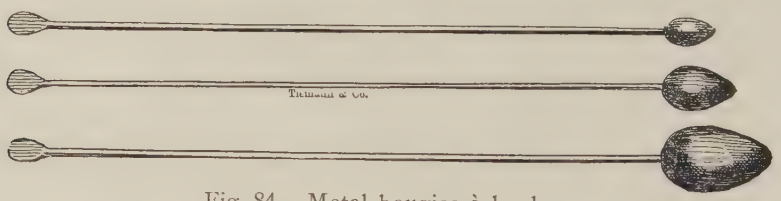

Fig. 84.—Metal bougies à boule.

the urethra, or one or more fine bands, like fiddle-strings, may be discovered. These changes are more easily felt upon the *withdrawal* of the bulb.

The **metal bulb** is less useful than the flexible bougie, as its smooth, polished surface glides over the roughnesses of the surface without being held by them.

The Otis urethrometer is chiefly used in measuring the *caliber* and determining the dilatability of the urethra. It has the advantage that it

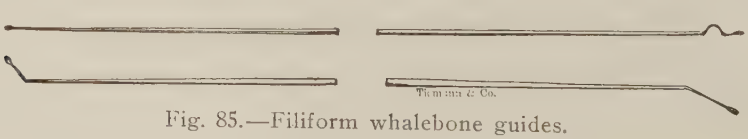

Fig. 85.—Filiform whalebone guides.

can be introduced through a narrow meatus and expanded *behind* the stricture, and we are enabled to measure its caliber with accuracy.

In the case of very tight strictures, in which the caliber is too small to allow the passage of the smallest bulbous bougie, we have recourse to **whalebone filiform guides.**

As long as urine flows out past a stricture we cannot speak of it as impassable, although the difficulty of entering it may be great on account of its fine, narrow lumen or because the opening is not central, but lying off to one side.

In order to find the opening it may be necessary to pass six or eight guides down upon the face of the stricture, and, with an assistant holding them firmly in place, try by twisting and manipulating successively one after another to find the opening through the stricture.

Fig. 86.—Heavy stricture of urethra and dilated pouch behind it. Hypertrophied bladder.

It is always desirable to inject ℥ij of olive oil into the urethra, to lubricate the canal and distend the narrow opening through the stricture.

Another manipulation, which sometimes succeeds, is to pass a sound down upon the face of the stricture, and hold it pressed firmly against it for ten to twenty minutes. In this way a certain amount of dilatation is often accomplished, and a funnel-shaped depression in the stricture is formed, with the opening at the bottom, instead of being located off to one side, as before.

In not a few instances the opening through the stricture can be discovered by visual inspection through an endoscope.

If great difficulty has been experienced in introducing a guide through a stricture, it is better not to withdraw it and take the chances of getting it in again, but tie it in, and leave it, either for the purpose of continuous dilatation or for operation.

TREATMENT.

All strictures, no matter where they are located, *if soft* and *recent,* are best treated by **gradual dilatation.** After the small round-celled infiltration has become converted into fibrillated connective tissue and is dense and contracted, dilatation no longer meets with the success which would have attended its use in the earlier stages. Even in these old cases, however, we can in many instances enlarge the caliber of the stricture and maintain it subsequently, by means of an occasional passage of a sound, at a size which does not obstruct the urinary outflow. On this account it is always well, in nearly every case, to try the effects of dilatation before proceeding to the more heroic measures of operation.

In private practice, where patients are more regardful of their health, and seek medical advice early, the larger proportion of strictures are amenable to treatment by dilatation. In hospital practice, on the other hand, patients are careless and neglect themselves, and when they do apply for treatment the stricture is apt to be so extensive and so firm and dense that operation is the only resource.

For purposes of dilatation we have recourse to:—

(*a*) Flexible bougies.

(*b*) Steel sounds, with the curve recommended by Van Buren.

(*c*) Kollmann's dilator.

Unlike the operative treatment, we may consider both regions of the urethra together in discussing the treatment by dilatation.

In the case of a stricture, particularly if located in the bulb or membranous urethra, which is **below No. 16 French in caliber,** we should always begin dilating with an **elastic bougie.**

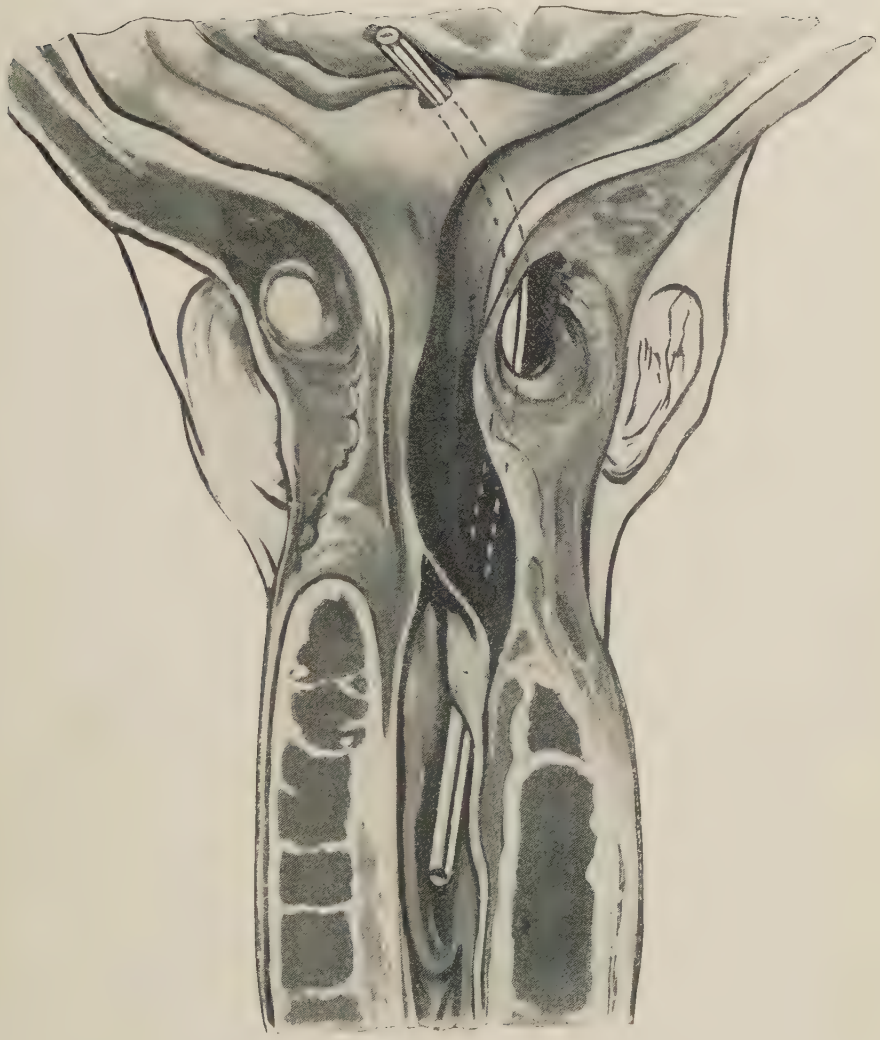

Fig. 87.—Stricture of the bulbomembranous urethra and false passage. The instrument has been forced through the tissues into the bladder.

If a metal sound is used, there is always danger of lacerating the inflamed and degenerated mucous membrane and pushing the sound into the periurethral tissue, making a **false passage.** If this accident occurs, the point of the sound is felt to be not in the median line, and is grasped firmly by the tissues, and a forefinger in the rectum readily detects the deflection of the instrument. Free hemorrhage from the meatus follows the withdrawal of the sound.

The treatment of such an accident consists in rest, urethral antisepsis, urinary antiseptics, and the avoidance of instrumentation for three weeks until the laceration has healed.

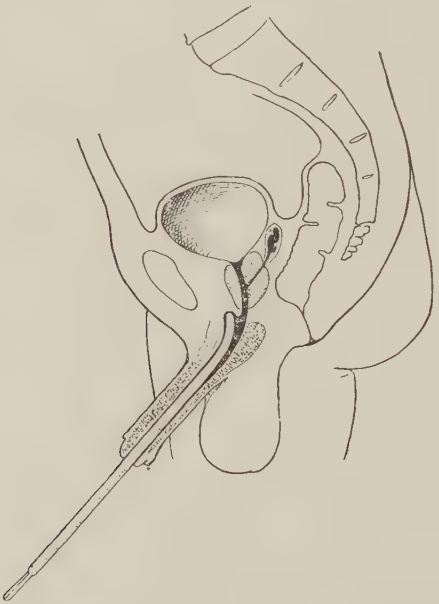

Fig. 88.—Sound perforating anterior wall of urethra at bulbomembranous junction.

In using an elastic bougie we should select a size which is small enough not to lacerate the tissues. When the bougie enters the stricture the sensation of its being engaged and grasped is perceived. If it is held very tightly, rather than attempt to push it ahead, it is better to wait a few moments till the spasm has relaxed, and then push the instrument farther along.

After the elastic bougie has been passed through the stricture, it can be withdrawn at once. There is no object in allowing it to remain, since it is compressible and cannot produce any absorption in the stricture; it simply dilates it mechanically. If the instrument has been

introduced with comparative ease, and without much pain, we may then introduce another of a larger size.

At the next sitting, which should not take place before two or three days have elapsed, we should first introduce the number passed upon the former occasion and then use larger sizes.

When the flexible bougie No. 16 French can be introduced with ease, we should begin **gradual dilatation with the steel sound.** It is important for the beginner to cultivate a suitable *technique* in using sounds, as unnecessary pain and sometimes actual damage to the tissues are caused by clumsy manipulation. The sound is sterilized by boiling or

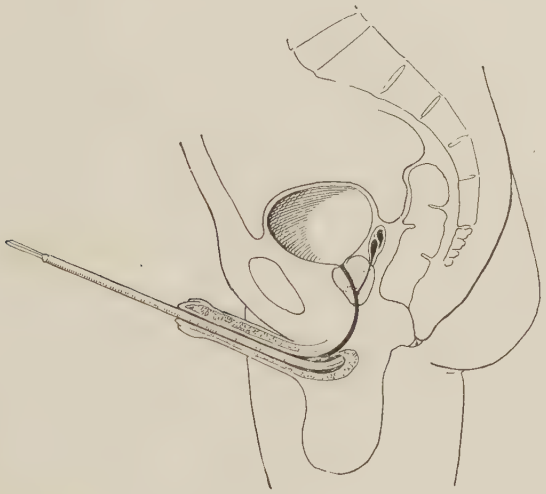

Fig. 89.—False passage. End of sound perforating urethra at bulbomembranous junction and wounding bulk of corpus spongiosum.

passing through the flame of a spirit-lamp, lubricated with vaselin or oil, and should be warm.

As the patient lies upon a table the operator stands upon his left side. Sir Henry Thompson advises that for the moment the operator should *forget* all his *anatomical knowledge,* and let the sound slip through the urethra *by its own weight,* guiding it with the utmost gentleness, and in no case should any pushing, prodding, or force be used. This is well accomplished by holding the sound *stationary,* in a line with Poupart's ligament, and drawing the penis up over it until the point of the sound has reached the membranous urethra. The sound is then brought into the median line of the body, and as the point passes *through* the membranous urethra the handle will of itself

describe the arc of a circle and gradually sink down between the thighs and parallel with them. When the handle is completely depressed, it may be rotated freely from side to side, thus demonstrating that the *point* lies in the bladder and is freely movable.

The largest-sized sound should be selected which will pass through the stricture without using force, withdrawn, and a still larger size introduced. It is desirable, in order to obtain the effect of the *prolonged* pressure, not to withdraw the sound at once, but to leave it lying in the stricture for from five to fifteen minutes.

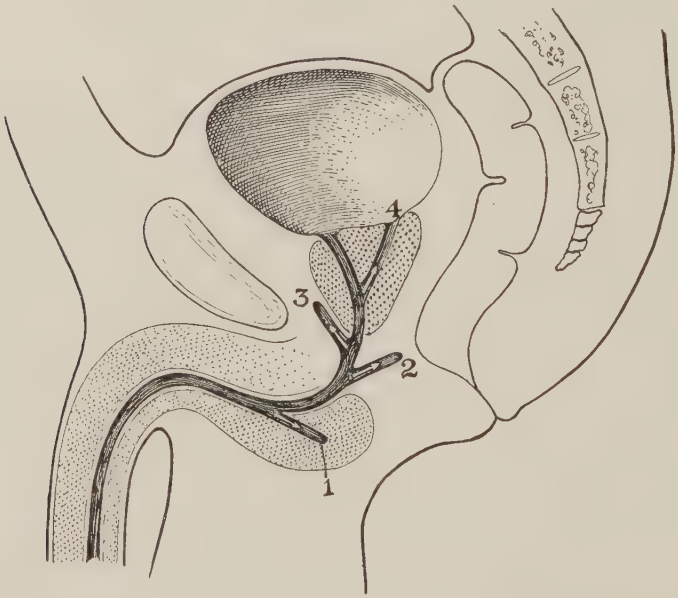

Fig. 90.—Various directions which false passages may take. 1. Into bulb. 2 and 3. Into tissues in front and behind. 4. Through prostate into bladder.

At the next sitting we should begin with the sound last introduced, withdraw it, and pass the next larger size. The sounds should not be passed too frequently, and the rule is always to *wait until the reaction has subsided* before passing the sound again. The intervals vary, depending on the amount of reaction, from four to seven days.

There are different views as to the extent to which it is necessary to carry the dilatation, some authorities claiming that No. 25 French is sufficient, others maintaining that No. 30 French is the proper caliber. In any case there is always danger of *recontraction* unless the sound is passed at occasional intervals, in order to maintain the maximum caliber, for at least eighteen months. We can introduce the sound every week,

and then increase the intervals to once in two, four, six, eight, and twelve weeks.

Effects upon the stricture of passing sounds are twofold, according to Oberlaender and Wossidlo:—

I. The mechanical stretching to which it is subjected.

II. A change in the vital functions of the tissues.

As a result of the distention, small *tears* occur in the mucous membrane or the stricture-tissue, as evidenced by slight bleeding. In a few hours a profuse mucous secretion occurs, indicating that a melting of the stricture-callus is taking place in consequence of the reaction. Under the increased vascularization which sets in, the stricture is partially absorbed.

After dilatation to No. 25 or 30 has been accomplished, the sound only acts upon the *narrowest* part of the stricture, and when it lies loosely here it accomplishes nothing further in the way of producing *absorption* of the stricture-callus, but only keeps its caliber *mechanically* dilated. But in many cases the stricture-tissue begins to recontract as soon as the use of sounds is discontinued.

Oberlaender claims that by dilating the stricture to more than No. 30 French, even 40 or 45, the fibrous tissue of the stricture is transformed into a "dead scar," which has no longer any tendency to contract. He states that, by systematic examinations with the endoscope, an evident improvement, which is perceptible to the eye, occurs only after the dilatation of the urethra has *exceeded* No. 30 French.

When the meatus is of normal size, it will not admit a sound large enough to accomplish this result, and, even if meatotomy is done, the meatus can only be cut to a size sufficient to admit a No. 30 French sound, and this caliber is not enough to accomplish the *overdistention of* the urethra, according to the views of Oberlaender. On this account he has devised the **Oberlaender dilator,** which can be introduced, with the blades closed, through a small meatus; after it is in place the blades are separated by turning the screw at the end, and we can get any amount of distention of the urethra which we may desire, even as high as No. 45 French. It should be distinctly understood that *forcible dilatation* or divulsion is not intended, but only a *gradual* and *temporary* dilatation of the stricture.

Kollmann's dilator is a modification of Oberlaender's original idea, and is to be preferred because it is made with four dilating blades and is less apt to cause a laceration of the urethra than Oberlaender's instrument.

Technique.—The dilator, which is provided with a rubber cover, is oiled and introduced. If the sound which was passed on the case

previously was No. 26, we separate the blades of the dilator to one number higher: *i.e.*, to No. 27.

The blades should be separated very slowly, and after we have screwed them apart *one* number, as indicated on the dial, we should

Fig. 91.—Kollmann's anteroposterior dilator.

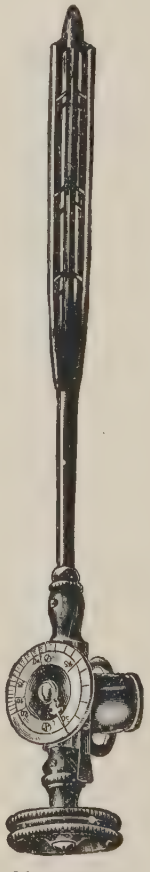

Fig. 92.—Kollmann's dilator for the anterior urethra.

wait until the pain has subsided, and then increase the separation to the next higher number.

After each dilatation a mucopurulent secretion occurs, which indicates the melting and absorption of the stricture-callus. If the discharge is profuse in quantity, it indicates that the stretching has been too

vigorous. The usual intervals for dilatation are about ten days, on the average, and at each sitting the dilatation should be increased from one to two numbers.

The extent to which the stricture should be finally dilated is a matter of individual experience, and beginners generally make the mistake of dilating too rapidly. A sharp bleeding or an excessive secretion following dilatation is an indication that an error has been made in the technique, and that the dilatation has been too rapid or too great. If such an accident occurs it is necessary to wait from three to six weeks, until all tenderness of the urethra has disappeared and the secretion has diminished and is but slight in amount.

In regard to the extent to which dilatation should be carried before the stricture can be said to be cured, Oberlaender states that the endoscope is the only guide. The grayish-white color of the mucous membrane changes and it becomes pink and vascular and the fibrous tissue becomes transformed into a "dead scar," which has no longer any tendency to contract. As soon as this condition is attained, all further dilatation can be suspended, quite irrespective as to whether the stricture has been dilated to No. 28 or 30, or to 40 or 45 French.

As a general rule, Wossidlo states that it is necessary to dilate up to 36 or 38 so that relapses do not occur, but, as with the use of sounds after active treatment has ceased, the stricture should be dilated, with the dilator, at occasional intervals to prevent relapses.

Relapses sometimes occur, and can be recognized by the endoscope and treated with dilatations again, before any decided contraction has had time to occur. For this reason, it is desirable to examine cases with the endoscope at intervals of three or six months after treatment has ceased.

With reference to treatment by dilatation, strictures may be divided into two classes, *absorbable* and *non-absorbable*. Those which cannot be absorbed can still be held in abeyance by a course of dilatations with sounds up to 30 or 32, and they may be kept at this point without contracting again by an occasional dilatation. The frequency of the dilatation will depend entirely upon the tendency of the stricture to recontract.

The length of time required to dilate a stricture is also very variable.

Some strictures can be dilated in a few weeks, and others, in which the ring of scar-tissue is extensive and very dense and fibrous, will require months of patient effort.

The only means of determining whether a stricture can be treated by dilatation is by making the attempt and observing the progress.

The opinion is now generally held, and particularly in Europe, that the great majority of strictures are amenable to treatment by dilatation, and operative treatment is seldom called for, provided the individual

has sufficient patience and time to undergo the protracted course of treatment which is necessary.

In private practice it is found that most of the strictures can be successfully treated by dilatation, and it is rarely necessary to operate. The patients who enter the hospitals in a large city are of a different class. Their strictures have usually been neglected and have become very tight, and they have not the necessary time or even inclination to allow of treatment by gradual dilatation, so that from force of circum-

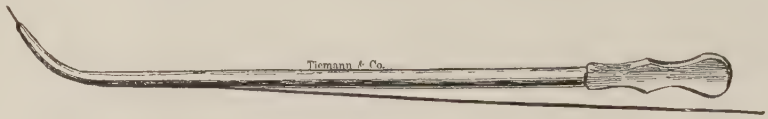

Fig. 93.—Tunneled sound.

stances the genitourinary surgeon is most frequently obliged to treat his hospital patients by surgical operation.

Strictures of very small caliber, which are so tight as not to permit the passage of the smallest flexible bougie, can often be penetrated by means of the **filiform whalebone guide.** After this instrument has penetrated the stricture and the end has entered the bladder, there are three courses open to us:—

(*a*) **Continuous Dilatation.**—If a bougie is passed through a stricture which grasps it tightly and is left in place for twenty-four hours,

Fig. 94.—Gouley's tunneled catheter.

the stricture ulcerates superficially, but *widens rapidly,* so that the bougie lies loosely within it, and can be withdrawn, and a larger instrument introduced to take its place.

In cases of retention of urine, a guide may be left tied in the bladder, and the urine escapes, flowing away alongside of the guide.

On the following days larger instruments may be introduced and tied in until the stricture is sufficiently dilated to admit being treated with sounds.

During the course of treatment the patient lies in bed, and it is possible in this way in the course of a week or two to dilate a very tight stricture so that a good-sized instrument can be passed.

Continuous dilatation, which formerly was much in vogue, is seldom used at the present day. Methods *b* and *c* have taken its place. It has, however, a certain field of usefulness in a few selected cases.

(*b*) **Tunneled Sound and Gradual Dilatation.**—A tunneled sound is threaded over the guide and introduced through the stricture, dilating it. The sound is then withdrawn, and a larger one introduced, in the same way. This is a very useful method of treating tight strictures, which are not too hard and fibrous to admit of gradual dilatation.

In case of retention of urine, where it is necessary to relieve a distended bladder, *Gouley's tunneled catheter* can be used in place of the tunneled sound, and the urine withdrawn through it, by pulling out the stylet and thus making the hollow shaft permeable.

(*c*) **Immediate Operation.**—Internal urethrotomy by Maisonneuve's urethrotome or external urethrotomy. (See the following section on the operative treatment of stricture.)

TREATMENT OF STRICTURE BY SURGICAL OPERATION.

As we have before stated, a *soft* or *recent* stricture, no matter in what part of the canal it is located, is best treated by *gradual* dilatation with sounds or dilators; but, as the stricture becomes older, it grows dense, firm, and fibrous, and the gradual dilatation is no longer practicable.

We are obliged to resort to a division or cutting through the stricture-band by means of the knife, and to that end we employ two different operations:—

(*a*) Internal urethrotomy.

(*b*) External urethrotomy.

The choice of the operation depends entirely upon the point in the urethra at which the stricture is located, and for the purpose of making the indications for operation clear we can divide the urethra into two regions:—

Region I extends from the meatus backward for a distance of five inches, and its termination corresponds to the penoscrotal junction.

Region II includes the bulbous and membranous urethra. It extends from a point five inches distant from the meatus back as far as the prostatic urethra.

The operation of internal urethrotomy through the meatus is restricted to Region I, and external urethrotomy through a perineal incision is only applicable to strictures located in Region II.

INTERNAL URETHROTOMY.

Preparatory Treatment.—Before *any* operation on the urethra the urine should be rendered aseptic by salol, gr. x *t. i. d.*, or urotropin, gr. vii *t. i. d.*, and if strongly acid it should be neutralized by citrate or bicarbonate of potassium.

The urethral canal should be irrigated with oxycyanide of mercury, 1:4000, to free it from germs as much as possible.

It is desirable to fill the bladder with oxycyanide of mercury by means of a catheter, and leave the fluid in, to flow out after the operation, bathing the cut surfaces and diluting the urine, when the patient urinates later.

Anesthetic.—A 1 per cent. solution of cocaine or novocaine is, as a rule, sufficient, unless in the case of very extreme strictures, which require a general anesthetic.

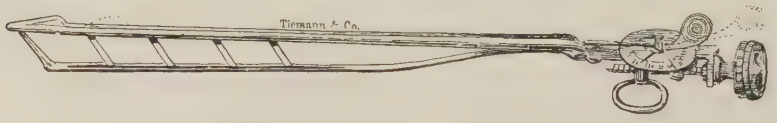

Fig. 95.—Otis urethrotome, as modified by Rand.

The **technique** of internal urethrotomy is as follows: If the meatus is small, it should be incised on the floor to No. 30 French, and any stricture-bands which are within an inch of it should be divided at the same time with a straight, probe-pointed bistoury.

The Otis urethrotome, preferably with Rand's modification, is introduced into the urethra closed. After its point has entered *behind* the stricture the blades are separated, by means of the screw, to the full extent the caliber of the stricture will allow. The instrument is then withdrawn until the projection at the end catches against the stricture and is held. We know by the feeling of resistance that the projection which conceals the knife lies in close contact with the point we wish to cut. The knife is then withdrawn for an inch, cutting through the stricture, and toward the *roof* of the urethra. And we can afterward readily demonstrate that the stricture has been cut through by separating the blades more widely than was before possible.

The knife is again pushed back into its place of concealment in the instrument, and the urethrotome is drawn out toward the meatus, and any other stricture-bands present are cut in the same way.

In every case treated by internal urethrotomy the question arises: "How deep shall we make the incision through the stricture?" This is still a point under discussion, since almost every author has his own

line of procedure. Dr. Otis devised a scale of measurements of the penis, as a guide to depth of the incision, and claims that a penis three inches in circumference should be cut to admit a No. 30 French sound, while a penis four inches in circumference should be cut so that a No. 38 sound can be passed.

I believe we shall have better results by treating each case on its *individual merits.* The stricture which is comparatively *light* and does not involve the whole corpus spongiosum may be *completely* divided, as shown by the entire *absence* of *resistance* when the blades of the urethrotome are separated, after cutting the stricture.

In the case of a *heavy* stricture which involves all the corpus spongiosum we cannot divide the whole thickness of the stricture, but must content ourselves with cutting it through *partially,* and trust to

Fig. 96.—Maisonneuve's urethrotome.

keeping the channel open by passing sounds *frequently* for the rest of the patient's life.

After the stricture has been cut to the extent which we desire and the urethrotome has been withdrawn, a bulbous bougie, No. 30 or 32 French, is introduced into the canal, to make sure that all the bands are completely divided.

After-treatment.—The patient should be kept in bed for a week, and on light diet, and directed to drink freely of water and milk to dilute the urine.

In order to keep the cut surfaces from growing together, a straight sound can be passed every other day for the first two or three weeks, and, after a month, once a week. Later the passage of the sound need only take place once a month; but there is always danger of *recontraction* unless a sound is passed at intervals.

Dangers of Internal Urethrotomy.—Mortality, 1 to 2 per cent.

(*a*) Hemorrhage.

(*b*) Infiltration of urine through wound into tissues, producing abscesses and septicemia.

(*c*) Urinary fever. It is especially important to see that the kidneys are healthy before doing an internal urethrotomy.

(*d*) Deformities of the penis subsequently.

When a deep cut is made into the roof of the urethra a large amount of scar-tissue is formed in healing. This scar subsequently contracts, and bends the penis into the shape of a bow, which causes erections to be painful, and renders coitus difficult or impossible.

Strictures of small caliber, under No. 18 French, are not large enough to admit the passage of an Otis urethrotome. In these cases a filiform guide should be passed through the stricture and by means of (*a*) Maisonneuve's urethrotome the stricture can be divided, from before backward, and afterward cut larger with an Otis urethrotome, or we can introduce over the guide (*b*) a divulsor and *stretch* the stricture so that an Otis urethrotome can be used.

The operation of **divulsion** as formerly practised has been entirely superseded, as it is inexact and dangerous, producing extensive lacerations of the urethra, which are followed by hemorrhage and septic absorption.

Summary of Indications for Internal Urethrotomy.—This operation is applicable only to stricture of the pendulous urethra which is dense and fibrous and cannot be treated by gradual dilatation with sounds, and located *less than five inches* from the meatus.

It is especially adapted to the following varieties:—

(*a*) Distinctly fibrous or non-dilatable stricture.

(*b*) Resilient stricture. (*Definition:* Elastic and India-rubber-like, contracting quickly after instrumentation.)

(*c*) Irritable stricture. (*Definition:* Standing instrumentation badly and easily excited to inflammation.)

(*d*) Cases where urethral fever follows each introduction of a sound.

When a stricture is located *more* than five inches from the meatus, internal urethrotomy is no longer a suitable operation, on account of the danger of **hemorrhage,** which is difficult to control. The blood flows backward, overcomes the resistance of the cut-off muscle, and fills the bladder.

The means of controlling the bleeding are as follows:—

(*a*) Pressure on the perineum by means of a crutch, firmly applied against it.

(*b*) Introduction of a full-sized catheter into the bladder, which makes pressure on the urethral walls and closes the bleeding vessels.

(*c*) Perineal section and introduction of a catheter through the wound into the bladder, with firm gauze packing around it.

Another danger is **infiltration of urine,** which soaks into the tissues through the cut and produces *abscess* and *sepsis.*

EXTERNAL URETHROTOMY.

In consequence of the dangers of hemorrhage and infiltration of urine, we have recourse to the operation of external urethrotomy through the perineum when the stricture is located in the **bulbous** or **membranous** urethra, viz.: in Region II.

Forms of Operation.—(*a*) With a filiform guide: Gouley's operation, modified by Rand.

(*b*) Without a guide: Wheelhouse operation.

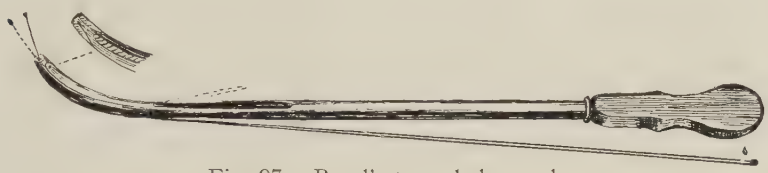

Fig. 97.—Rand's tunneled sound.

Gouley's Operation with a Guide, as Modified by Rand.—The technique of the operation is as follows:—

A filiform guide is introduced through the stricture into the bladder and the patient placed in the lithotomy position.

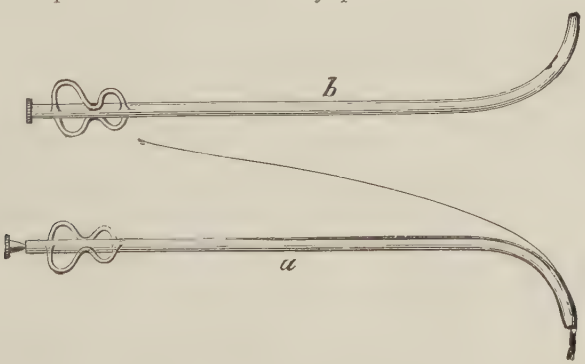

Fig. 98.—Gouley's catheter-staff.

The staff is the ordinary tunneled sound made to slip over a filiform guide, but, while the tunneled sound is provided with one groove on its convex surface, this instrument has two grooves, one on the convex side and the other on its concavity.

The staff is then slipped over the guide, which lies in the groove on its concavity, the staff thus acting as a shield to prevent the accidental cutting of the guide.

The point of the staff rests against the face of the stricture and the urethra is opened in the perineum by cutting down upon its convexity near the end.

Hemorrhage is prevented by pressing with the finger and thumb on either side of the urethra. When the urethra is reached it is made to stand out prominently in the perineum by blunt dissection; it is then opened in the median line.

The staff is withdrawn from the urethra, the guide being held with forceps to prevent it from being pulled out of the bladder. The long end of the whalebone guide is then brought out of the wound in the perineum, the other end remaining in place in the bladder. Rand's knife is then threaded over the guide and pushed forward toward the

Fig. 99.—Tunneled knife.

bladder, and through the stricture, cutting its fibers sufficiently to admit a gorget, which is carried into the bladder.

Any remaining stricture-bands which have not been severed by the ringed knife should now be divided on the floor of the urethra with a blunt-pointed straight bistoury, using the gorget as a director.

The vesical sphincter may then be dilated with a uterine dilator and the examining finger introduced into the bladder. Thorough search should now be made with the finger to exclude the presence of a calculus, which may have existed unsuspected, its symptoms being masked by those of the stricture.

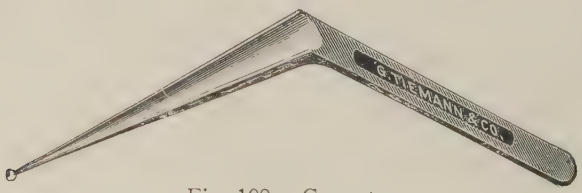

Fig. 100.—Gorget.

Operating in this way, it is possible to get on with a much smaller incision than is usually made in the urethra. If a larger incision has to be made it is usually desirable to partially close the wound in the urethra with sutures and also the skin and muscle lying over it. This partial closing of the wound around the tube hastens the process of repair materially, so that a week after the operation the patient is passing the whole or nearly all of his urine through the urethra.

The final step in the operation consists in introducing a large soft-rubber perineal drainage tube through the wound into the bladder and holding it in place by a stitch through both lips of the wound and the tube.

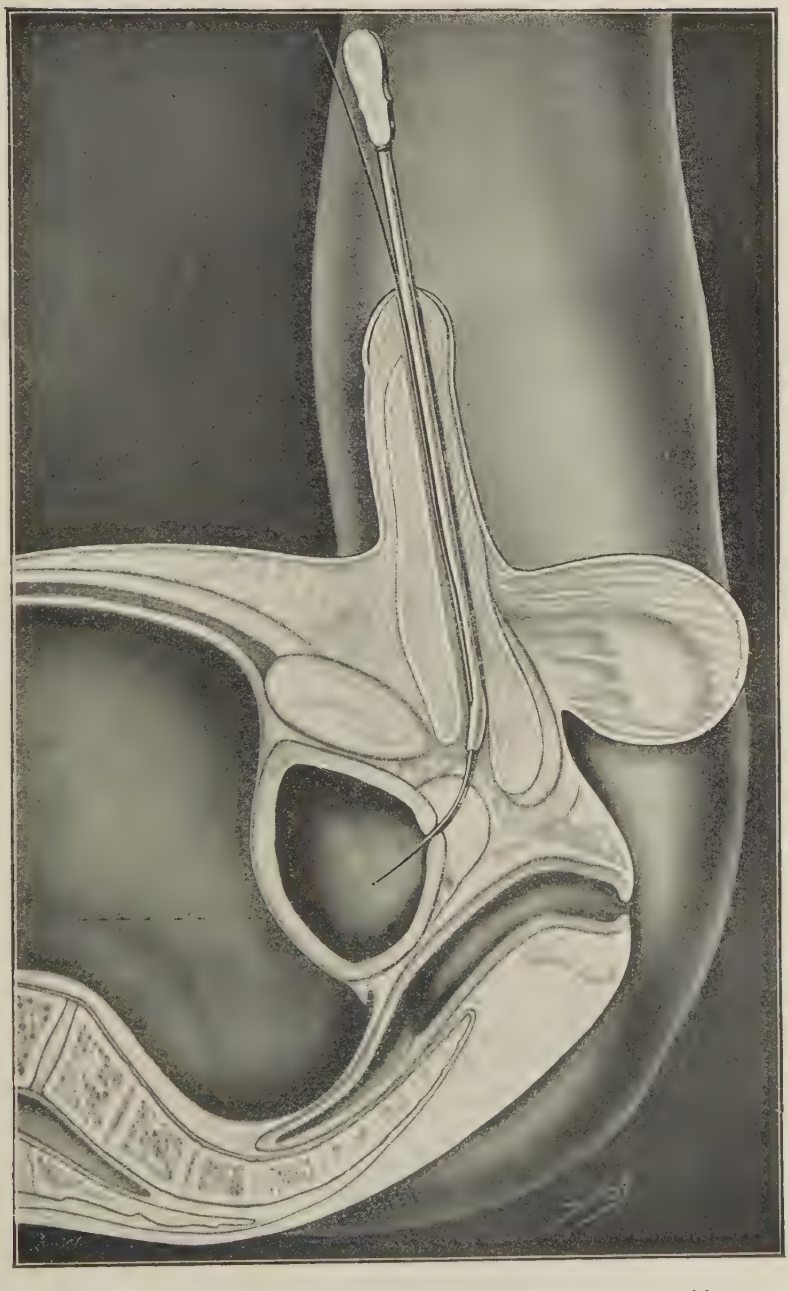

Fig. 101.—Rand's staff introduced over a filiform guide to face of the stricture.

The wound is packed around the tube with strips of iodoform gauze to prevent hemorrhage.

The operation of external urethrotomy is rendered comparatively simple, if we are able to introduce a filiform guide into the bladder, and it may be impossible to reach the bladder without the assistance furnished by the guide.

For that reason it is desirable not to wait until the last moment before the operation, but to begin the attempt to introduce a guide on

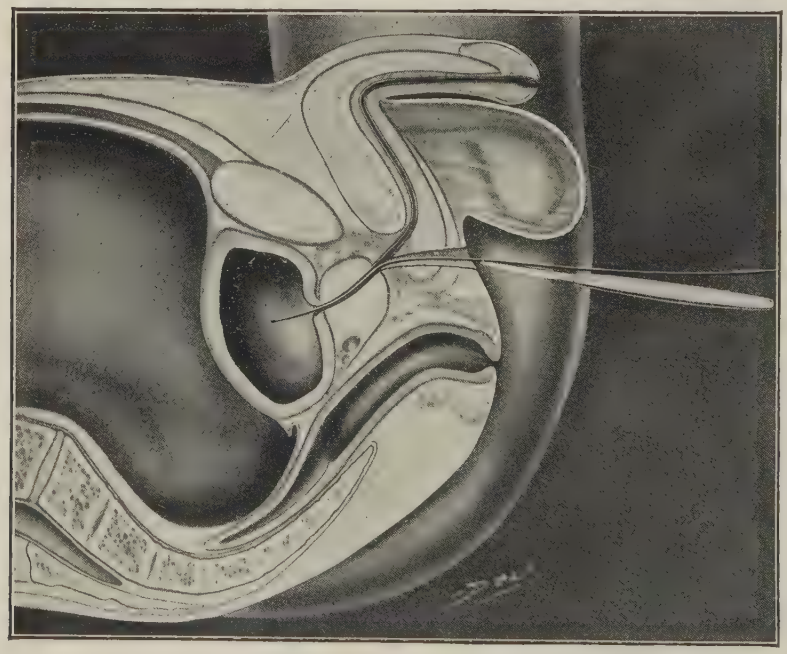

Fig. 102.—Rand's knife introduced over filiform guide, preparatory to cutting stricture.

the day before. If the first attempt fails, a number of subsequent trials may be made at different sittings, at one of which the guide generally slips in.

After the guide has once been introduced into the bladder through a very tight stricture, it is much safer to tie it in and leave it, rather than withdraw it and take the chances of failure in attempting to reintroduce it just before the operation.

When all attempts at the introduction of a guide are unsuccessful, the only remaining resort is the question of

External Urethrotomy Without a Guide, as Devised by Wheelhouse.—*Technique.*—A Wheelhouse staff is introduced into the ure-

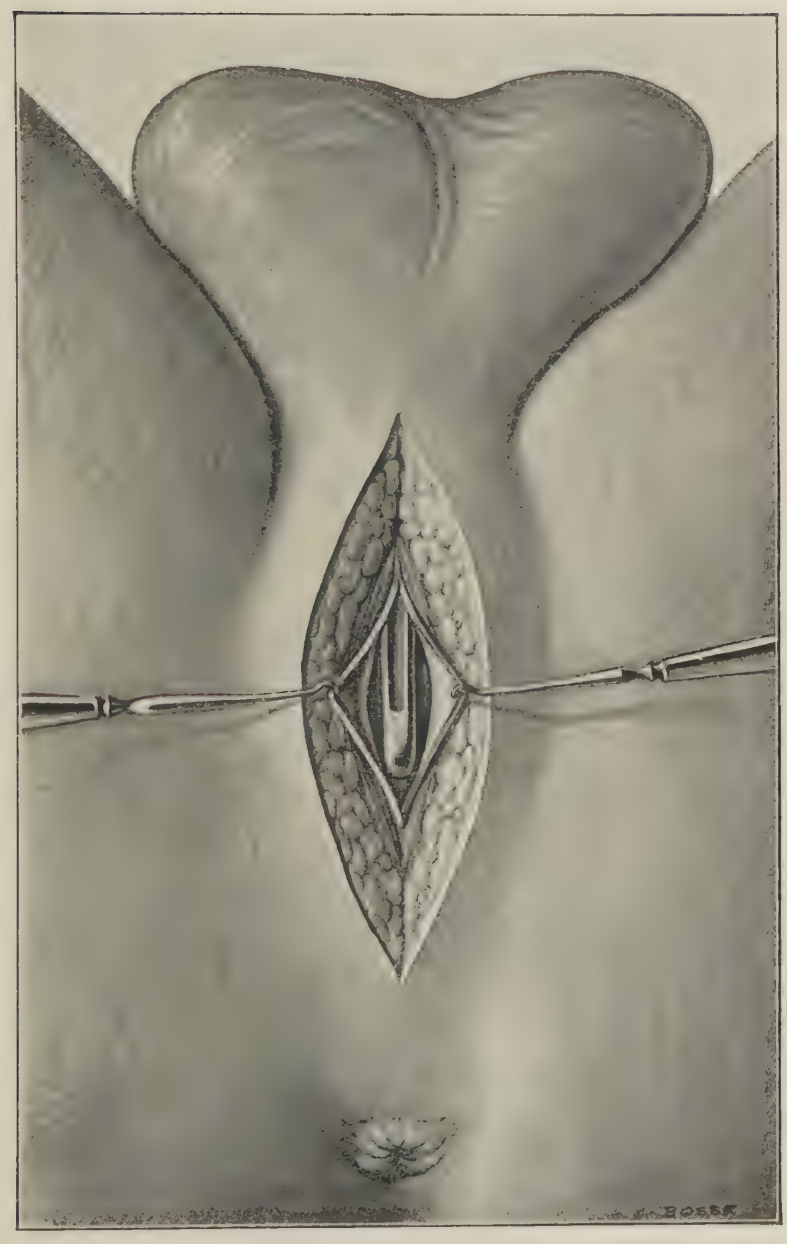

Fig. 103.—External urethrotomy. Wheelhouse operation. Urethra opened on staff.

thra, till its end rests against the face of the stricture. The urethra is opened through the perineum, cutting down upon the end of the staff. The wound in the urethra is retracted by small hooks on either side, and the upper angle of the wound is held up by hooking the projecting end of the staff against it and drawing it as much out of the way as possible.

Search is then made for the distal end of the urethra by means of Arnott's grooved probe or a filiform guide and by inspection. If the opening is found and the probe introduced, a Gouley knife is slipped along the groove in the probe and the stricture is cut through.

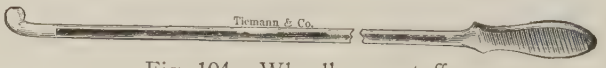

Fig. 104.—Wheelhouse staff.

The chief difficulty, in the operation of external urethrotomy, consists in finding that part of the urethra which lies between the stricture and the bladder.

If the surgeon loses his way and misses the urethra, he may flounder about in the tissues of the perineum indefinitely, and ultimately have to give up his attempt to reach the bladder.

In order to avoid the danger of losing the urethra, it is essential to partially dissect out and free the urethra at the sides, so that it stands out prominently in the perineal wound as it lies distended by the staff.

Fig. 105.—Small tenaculum for retracting urethral wound in external urethrotomy.

After the incision is made in the urethra, the edges of the urethral wound should be well retracted by a small hook at either side, and but little difficulty will be experienced in slipping Arnott's grooved probe through the lumen of the stricture with the deep urethra and bladder beyond.

In case of failure to find the opening we may have recourse to **Guitéras's trocar.** The rami of the pubis form a triangle, with the symphysis at the apex. The urethra lies immediately under and one-half inch below the symphysis.

If our anatomical knowledge enables us to locate the urethra accurately, by *stabbing,* in the proper place with the trocar, we will puncture the stricture-tissue, and the trocar will lie in the prostatic urethra beyond, as can be demonstrated by pushing the trocar along through it, until it reaches the bladder, and withdrawing the stylet, when

a stream of urine will flow through the hollow cannula. A knife is then introduced along the groove in the instrument and the stricture divided in the usual way.

In the event of this procedure not being successful we may have recourse to **retrograde catheterization.** This operation consists in doing a suprapubic cystotomy and introducing a staff into the bladder and through the prostatic urethra and along the canal until its further progress is barred by the stricture, through which it cannot pass. The end of the staff is felt, covered by stricture-tissue, by means of a finger in the wound, and the tissue which intervenes between the end of the

Fig. 106.—Arnott's grooved probe.

staff and the perineal wound is cut through with a knife, in this way bringing the end of the staff into view in the wound. The urethra is thus made again one continuous canal.

We may have recourse to still another procedure, which is to let the patient recover from his anesthetic, and when consciousness is restored and the bladder is full of urine, if the patient endeavors to pass water, a few drops of urine may be seen to escape at one point in the perineal wound, thus indicating the location of the end of the urethra, which had not been discoverable before.

Fig. 107.—Gouley's beaked bistoury.

Treatment After External Urethrotomy.—*Hemorrhage* during the operation is controlled by clamping the bleeding vessels with artery-forceps, which, if necessary, may be left *in situ* for twenty-four hours in the wound, before being removed. As a rule, this is unnecessary, as the general oozing can be perfectly controlled by firm pressure by means of gauze, packed into the wound and around the catheter.

It is very essential to pack the gauze in *tightly*. The author has known of several cases where the gauze was packed in loosely and did not exert enough pressure to control the bleeding, and the patient had secondary hemorrhage from two to four days after the operation. The bleeding occurred at night and was not discovered until too late to save the patients' lives.

The treatment of secondary hemorrhage consists in taking out the gauze and clamping any bleeding points, if they can be seen; or a firm repacking of the wound with gauze will probably control the hemorrhage.

Saline injections, transfusion, or hypodermoclysis, together with strychnine administered hypodermically, are, of course, indicated in such a condition.

An important indication is to secure *good drainage of the bladder* and prevent the urine from coming in contact with the freshly made wound until septic absorption is guarded against by the formation of granulations. This is readily accomplished by carrying a No. 34 French catheter through the wound and into the bladder, and taking a stitch through both lips of the wound and the catheter to prevent it from being forced out. The end of the catheter is attached to a long tube, which drains into a bottle on the floor.

In a case where, in addition to cutting a stricture in the deep urethra, a stricture in the anterior part of the canal has been divided by internal urethrotomy, a straight sound should be passed through the meatus and anterior urethra down to the catheter on the second day after the operation and upon every alternate day until the drainage tube is removed

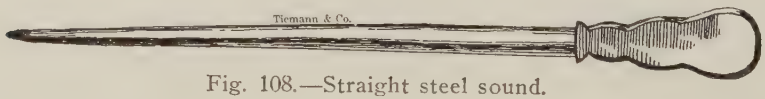

Fig. 108.—Straight steel sound.

from the wound and bladder. The gauze packing should be removed from around the tube in forty-eight hours and the wound irrigated and repacked.

The gauze can be loosened and prevented from adhering to the wound and causing bleeding by its removal by injecting equal parts of extract of hamamelis and peroxide of hydrogen into its interstices before beginning the attempt to remove it.

It is desirable to irrigate the bladder with oxycyanide of mercury, 1 : 4000, once or twice a day. On the fourth or fifth day after the operation, when granulations have formed, the perineal drainage tube should be removed from the wound and at the end of a week a curved sound should be passed through the meatus into the bladder.

The sound is passed every second day into the bladder until the perineal wound is healed and the patient discharged.

The patient may be allowed to get out of bed and sit in a chair a week after the operation, and the ability to hold the water and pass it at will is regained about the same time.

Recontraction of the stricture is almost certain to take place, after division of a heavy stricture, unless a sound is passed at occasional intervals, for the rest of the patient's life, and this fact should be earnestly impressed upon him, so that he may not neglect the precaution.

Résumé.—External urethrotomy is applicable *only* to strictures located *more* than five inches from the meatus, *i.e.*, in the bulbous and membranous urethra.

Summary of indications:—

(*a*) Rupture of urethra.
(*b*) Urinary infiltration.
(*c*) Impassable stricture complicated by retention of urine.
(*d*) Tough fibrous stricture of small caliber which is difficult to dilate.
(*e*) Traumatic stricture.

MISCELLANEOUS.

Stricture at the meatus may be congenital or the result of gonorrhea. In these cases dilatation is useless, and the proper procedure is meatotomy, which is accomplished by cutting the meatus upon the *floor* by means of a straight probe-pointed bistoury.

There is a tendency on the part of the cut surfaces to unite afterward, which is counteracted by *dilating* the meatus three times daily with a sound, or preferably a glass cone.

Stricture Complicated by a False Passage.—A large number of cases of *old* deep-seated stricture, which have been under instrumentation a number of times, are apt to have one or more false passages, which have been made by the bungling use of a sound.

A false passage adds to the difficulty of entering the bladder with a catheter or sound, because it is very apt to engage the point of the instrument and "pocket" it.

In these cases the *filiform bougie* is very serviceable in furnishing a guide into the bladder. Our plan of procedure is to introduce one guide after another through the urethra, in hopes that one of them will slip *past* the opening of the false passage, pass through the stricture, and thus into the bladder.

Combined external and internal urethrotomy is always demanded when both pendulous and bulbous portions of the urethra are the seat of strictures.

It is also often a good plan to open the perineum and drain the bladder with a catheter after an extensive internal urethrotomy, in order to prevent the urine from passing over the fresh-cut surface in the urethra and causing urinary fever.

PERINEOURETHRAL FISTULA.

Occasionally after an external urethrotomy a permanent fistula is left in the perineum, which communicates with the urethra.

This is particularly liable to occur when a patient has been operated on several times for stricture by external urethrotomy, and when a considerable amount of scar-tissue has formed in the perineum.

Urethroplasty frequently fails in these cases, because the urine leaks into the stitch holes, causing suppuration and separation of the wound-surfaces.

The author has succeeded in healing some intractable fistulæ which had been previously operated upon unsuccessfully, by the following method:—

The patient is placed in the lithotomy position and a sound introduced through the meatus into the bladder.

The cicatricial tissue surrounding the edges of the fistula is dissected away and the perineal tissues separated from the urethra.

The edges of the fistulous opening in the urethra are then freshened and brought together and held by catgut sutures.

The perineal wound is then closed by means of silver-wire sutures and the bladder is drained with a retained Pezzer catheter or the patient is catheterized every four hours. The latter method is to be preferred, if competent nursing is at hand.

Firm union generally takes place at the end of a week and the silver-wire sutures may be removed.

TREATMENT OF INTRACTABLE STRICTURE BY RESECTION OF A PORTION OF THE URETHRA.

Occasionally dense fibrous strictures of the deep urethra, with a large amount of periurethral induration, are met with, which are sometimes gonorrheal, but generally traumatic, in origin.

Such patients have usually had their stricture divided by external urethrotomy several times, but, in spite of the regular passage of sounds, they contract rapidly, and it is impossible to keep them open.

A conservative method of dealing with such cases is to lay bare the urethra and excise the strictured portion.

This was first done by König in 1882, who cut out the strictured portion of the urethra and brought the separated edges again into apposition and stitched them together. In 1892 Guyon and Albarran resected strictures and allowed the space between the cut ends of the urethra to fill in with granulations.

The author has used the method devised by Fuller with satisfactory results.

Technique.—A sound is introduced through the meatus and the perineal urethra exposed by dissection. If the bulbous urethra is in-

volved, the scrotum must be split in two halves in order to lay the urethra bare. The strictured portion of the urethra is entirely excised with curved scissors, with the exception of a narrow bridge of urethral tissue one-quarter of an inch wide on the roof.

A large catheter is inserted at the lower angle of the perineal wound to drain the bladder, and a No. 26 French soft catheter is passed through the meatus and perineal urethra, till its end rests against the perineal tube. The perineal tissues are then sewed around the urethral tube with catgut, thus building up a channel which will eventually form the new urethra.

The skin-edges are then brought together with superficial sutures, and, if the scrotum has been divided, a couple of deep silkworm-gut sutures may be introduced.

Both tubes may be removed in one week, but a sound should not be passed for three weeks.

EXTRAVASATION OF URINE.

Extravasation of urine is one of the severest and most dangerous complications which occur as a result of stricture. It is by no means uncommon, and Sir Henry Thompson found it occurring 8 times out of 217 cases of stricture.

The long-continued inflammation of the mucous membrane lining the pouch-like dilatation behind the stricture frequently causes a necrosis of the tissues and the urine escapes into the periurethral cellular tissue. The escape of the urine is also no doubt assisted by the straining and pressure of the hypertrophied bladder during its attempts at evacuation.

When, as is most frequently the case, the rupture occurs *in front* of the subpubic ligament, the urine burrows through the cellular tissue of the scrotum and penis and extends upward toward the hypogastrium.

Abscess rapidly forms, the tissues become gangrenous and slough, and spontaneous evacuation of the pus and urine occurs with considerable destruction of tissue, leaving urinary fistulæ. The septic condition is always very pronounced, and such patients usually die unless an operation is performed promptly after the rupture occurs.

When the rupture of the urethra takes place *posterior* to the subpubic ligament, the burrowing of urine takes place in a different direction. In this case the urine cannot make its way forward through the cellular tissue of the penis, but it burrows under the deep layer of the perineal fascia and accumulates in the prevesical space, forming a swelling above the symphysis. From this point it extends, and inflammatory swelling and suppuration of the connective tissue within the abdomen occur, and the patient dies of pyemia.

TREATMENT.

Urinary extravasation demands immediate operation in order to save the patient's life and prevent extensive sloughing and loss of tissue.

An external urethrotomy should be performed and the bladder drained through a catheter in order to prevent further escape of urine into the tissues. At the same time the collections of pus and urine in the tissues should be opened up, drained freely, and packed with gauze.

Fig. 109.—Extravasation of urine into tissues of penis and scrotum.

If the prostatic urethra was ruptured behind the subpubic ligament and extravasation has taken place into the prevesical space, the pus and urine should be evacuated by means of a suprapubic incision.

RETENTION OF URINE.

When called to see a patient who cannot urinate, the surgeon should bear in mind three possible conditions:—

(*a*) **Retention of urine in the bladder.**

(*b*) **Suppression of urine** from a failure on the part of the kidneys to secrete.

(*c*) **Rupture of the bladder.**

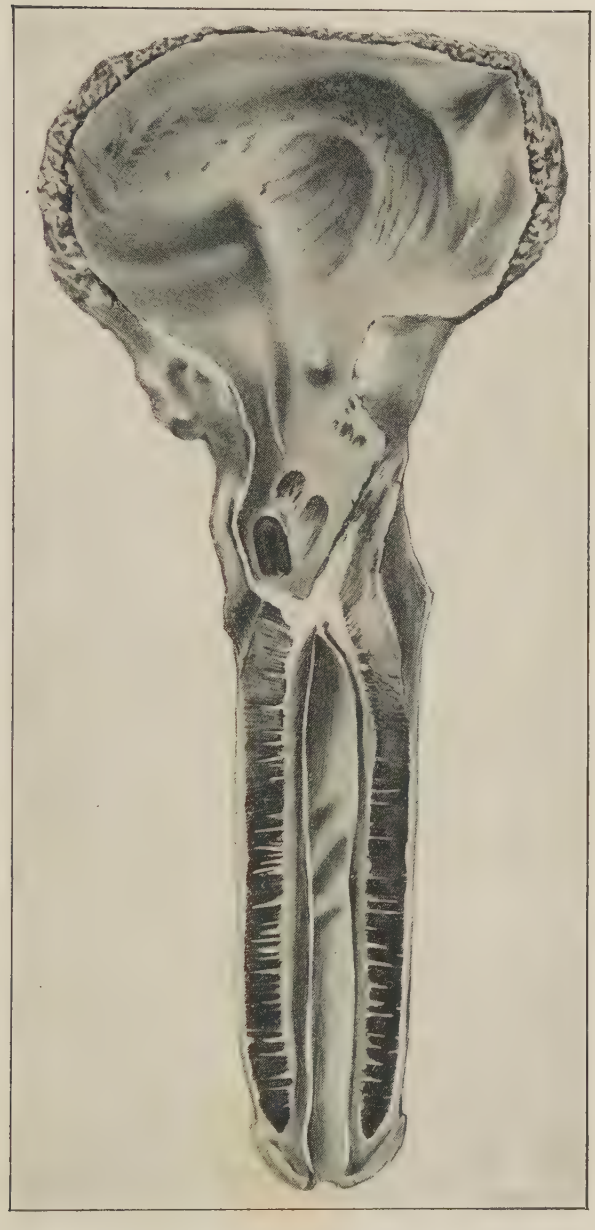

Fig. 110.—Ulceration of urethra with extravasation of urine behind a stricture.

In *suppression of urine,* percussion over the bladder shows it to be empty, and the catheter, which is easily introduced, draws no water.

Rupture results, in very rare instances, from a chronic ulcer being torn asunder by the violent muscular contractions of the bladder-wall. It usually occurs, however, from the patient falling upon his abdomen when the bladder is moderately distended with urine.

In making a diagnosis, a catheter is introduced through the urethra and little or no urine flows out; a measured quantity of water is then injected into the bladder with a syringe, and the full amount introduced does not return.

Having excluded rupture of the bladder and suppression of urine, we know that we are dealing with a case of retention of urine, which may arise from the following causes:—

I. **Stricture,** which may be spasmodic or organic.

II. **Enlarged prostate,** from senile hypertrophy or gonorrheal inflammation.

III. **Foreign body impacted in the urethra,** as a calculus which has formed in the bladder and undergone spontaneous fracture, and a piece become fixed in the urethra; or some article may have been introduced into the urethra from without, for purposes of masturbation.

IV. **Paralysis of the bladder,** occurring in typhoid and other continued fevers, or from myelitis, hemiplegia, and other nervous affections.

In order to determine which of the above conditions is responsible for the retention, a systematic method of examination is to be recommended.

Percussion over the suprapubic region gives a flat note with a full bladder, and the bladder can often be felt extending upward toward the umbilicus.

The condition and size of the *prostate* should be ascertained by rectal examination.

In cases of paralysis of the bladder no difficulty is experienced in introducing a catheter; but if the retention is due to stricture, the catheter fails to pass and the urethra should be explored with a steel sound.

If the stricture is purely *spasmodic,* a large-sized sound will generally overcome the spasm and slip into the bladder; but if the stricture is *organic,* the sound is arrested.

In very tight organic strictures which do not admit a steel sound, a filiform guide can usually be introduced.

TREATMENT.

If the retention is due to stricture, either organic or spasmodic, a quarter or half a grain of morphine given hypodermically, in conjunction with a full hot bath for half an hour, often relieves the retention.

Before using the hot bath, however, an attempt should always be made to pass a catheter, either soft rubber, woven silk, or silver. If the silver catheter is used, extreme care should be taken to avoid making a false passage.

Before passing an instrument into the bladder in any case of retention of urine, the urethra should be injected with a 4 per cent. cocaine or 2 per cent. eucaine solution, and very thoroughly irrigated with a 1:4000 oxycyanide of mercury solution, in order to prevent the subsequent dangers of cystitis and urinary fever.

A spasmodic stricture is always overcome by the above measures, but an organic stricture generally proves more rebellious.

In an organic stricture, when a catheter cannot be passed, the surgeon can usually relieve the retention by means of a filiform guide, introduced into the bladder with Gouley's tunneled catheter slipped over it.

Passing the filiform guide may be facilitated by filling the urethra with sweet oil by means of a syringe.

Adrenalin solution injected against the face of the stricture often causes it to shrink and open so that a guide will pass.

Sometimes it is possible to see the opening through the stricture, by means of a urethroscope, and the guide can be passed under the direction of the eye. After the guide has entered the bladder and the urine has been drawn off with a Gouley catheter, the practitioner is called upon to decide the question as to whether the patient shall be treated by *continuous dilatation* or by *operation.*

If a surgeon of experience can be secured, a stricture which is so tight that it will only admit a filiform guide is best treated by urethrotomy; but if the patient does not consent to operation, continuous dilatation will generally enlarge the stricture so that it can be subsequently treated with sounds.

In the cases where a guide fails to enter, the distended bladder may be emptied by plunging an aspirating needle through the abdominal wall, a finger's breadth above the pubis, and drawing off the urine with the aspirator. This affords only a temporary relief, as it cannot be repeated more than once, on account of the danger of infection of the punctures and the leakage of urine into the space of Retzius. The last and only resource in these cases is external urethrotomy without a guide.

In the cases where the retention of urine is due to **enlarged prostate,** the treatment must be conducted on entirely different lines.

Here it is better not to waste time with a hot bath, but use the catheter at once.

In gonorrheal prostatitis the urethra should always be washed out thoroughly before passing the catheter, to prevent infection of the bladder.

In senile hypertrophy of the prostate, the distended bladder should never be emptied at one sitting, but a few ounces of urine or boric acid solution should be left in.

If the bladder is emptied entirely there is some shock, the distended blood-vessels lose their accustomed support and bleed freely, and a cystitis is always aggravated if already present.

If a **foreign body impacted in the urethra** is the cause of the retention, it may sometimes be extracted with long urethral forceps.

A foreign body, however, usually calls for operation, either perineal section, or, if the body is large and lies in the bladder with part projecting into the urethra (pipestem calculus), suprapubic cystotomy may be required.

If the stone is impacted in the pendulous urethra, it may be cut down upon directly through the skin and urethral tissues. Such always heal readily by granulation without leaving a fistula.

CHAPTER X.

URINARY FEVER, OR UROSEPSIS.

Urinary fever is the most important postoperative complication which the genitourinary surgeon is called upon to treat, and by far the largest proportion of patients who die after operations on the prostate, bladder, or kidneys perish as a result of this condition.

The element of nervous shock attendant upon instrumentation of the urethra and bladder was formerly thought to be responsible for the clinical manifestations, but urinary fever is generally regarded at the present time as an *infectious disease* which is brought about by the entrance of pathogenic organisms into the blood-circulation, through wounds or lacerations of the urethra or bladder. Among various other organisms the colon bacillus plays an important part in the causation of urinary fever. Micro-organisms and their toxins may be brought into the blood-circulation in various ways.

The sound or catheter may be dirty and infected with germs which are introduced into an accidental laceration made in the mucous membrane by the instrument. With the present methods of asepsis, this is unusual and the organisms are generally already in the urogenital tract. The normal urethra is probably fairly sterile, but in the dilated pouch behind every stricture numerous organisms are always present, and in every case of cystitis and pyelitis the urine contains numbers of germs.

After a solution of continuity, made either by an accidental traumatism or by an operation wound, a gateway is opened for the entrance of organisms and their toxins into the blood-current.

The *course of the fever* depends upon the size of the wound and the quantity of micro-organisms absorbed. If a small amount of septic material is taken up in oft-repeated doses, the fever runs a chronic course.

In case the kidneys were diseased and incapable of eliminating waste-products completely before the onset of the fever, the attack is more severe, inasmuch as the kidneys fail to excrete the products of nitrogenous waste and, in addition, cannot clear the blood of the accumulated toxins.

Clinically three forms of urinary fever are observed:—

Acute Transitory Urinary Fever.—Shortly after instrumentation of the urethra or bladder—*i.e.*, passing sounds, dilatation, urethrotomy, or cystoscopy—a chill occurs, lasting half an hour or more and followed by

fever, and the urinary secretion is lessened or entirely suppressed. After a few hours the temperature falls, with profuse sweating; the kidneys begin to secrete freely again, and the urine contains abundant urates and sometimes albumin.

It was such cases as these that gave rise to the opinion that the phenomena were due to nervous shock from the instrumentation, but, as the chill never follows the instrumentation immediately, but always several hours later, and usually after the patient has voided his urine, it is reasonable to exclude the element of nervous disturbance and regard the symptoms as due to absorption.

In strong, healthy men with sound kidneys the symptoms described above need cause no anxiety. The attack is transient and lasts only a few hours, and after three days the feeling of prostration passes off and the patient is none the worse for his experience.

In order to lessen the chance of urinary fever certain conditions are necessary:—

I. Healthy kidneys. As already stated, imperfect elimination of urea predisposes strongly to urinary fever; hence it is important to ascertain that the kidneys are healthy before operating on the urethra.

II. Complete asepsis of instruments and genitourinary tract. It is easier to secure asepsis of instruments (see section on care of instruments) than to sterilize the genitourinary tract. A good deal can be accomplished in that direction by irrigations of the bladder and urethra, before instrumentation, with oxycyanide-of-mercury solution, 1:4000.

The urine should be sterilized by the administration by the mouth of salol, gr. x, three times a day, or urotropin, gr. vii, three times a day.

III. All instrumentation should be made with the utmost gentleness, to avoid causing lacerations. By avoiding any tearing of the mucous membrane there is no opportunity for micro-organisms to make their way into the blood-current and so excite the fever.

Treatment of the Attack.—As already stated, after the chill the fever soon subsides, when the patient breaks out into a very profuse sweat, and the indication, therefore, is to encourage free perspiration by putting the patient to bed, surrounding him with hot bottles, and giving a hot drink.

Phenacetin is useful for the headache, and a saline cathartic should be given the next day to complete elimination of the toxin.

The chronic form may follow an acute attack. The temperature, instead of becoming normal with a profuse diaphoresis, remains slightly elevated in the morning, with a pronounced evening rise, and the fever is of the remittent type. After lasting five or six days, the fever breaks up, with a free sweating.

Another form which chiefly affects old men suffering from chronic retention of urine begins very insidiously. The temperature is only slightly elevated in the evening, but the patient is not aware that he has fever, and may go on for weeks before the thermometer is used and discloses a rise.

He usually consults a physician on account of digestive disturbances, complaining of dry tongue, want of appetite, and difficulty of digestion; vomiting or diarrhea is often present.

There are always mental symptoms, dull headache, confusion of mind, and at night, when the temperature is elevated, mild delirium and moderate sweating.

The patient emaciates slowly, the skin appears dry and wrinkled and of a yellowish-white color, and only after a number of weeks is the cachexia well established. With an elderly man complaining of such indefinite symptoms, a urinary examination will always show marked changes.

The urine contains pus in considerable quantities, usually more albumin than would be accounted for by the pus, indicating involvement of the kidney parenchyma. The specific gravity is usually low, and the reaction is often alkaline and the odor frequently ammoniacal, or distinctly fecal if colon infection is present.

In these cases of chronic urinary fever a severe cystitis is always present, and most frequently a secondary ascending infection of the kidneys has taken place, with a pyelitis or pyelonephritis.

The symptoms of toxemia are due to the absorption of bacteria and toxins, in small quantities and for a long-continued time.

In such a condition as described any operative interference, such as prostatectomy or crushing a stone in the bladder, or even reckless catheterization, is fraught with great danger to the life of the patient.

The crippled kidneys cease their function entirely, and the patient dies of *septic anuria.*

Treatment.—The first indication is to provide free drainage for the bladder, and so prevent any further absorption.

This may be accomplished by gradually emptying the bladder with a catheter if it be overdistended. This requires about a week and should be accomplished by drawing off a small quantity of urine several times a day. After the bladder has been emptied, a permanent catheter may be worn and the bladder irrigated with silver nitrate solution, 1 : 4000.

If the conditions are so threatening that a radical procedure must be adopted at once, a rapid perineal section or suprapubic cystotomy under cocaine will serve to drain the bladder and stop further absorption.

The second indication is to assist the kidneys in their efforts to eliminate the toxins. This can best be accomplished by causing the patient to drink large quantities of pure water.

Colonic irrigation by the drop method (Murphy drip) may be required in the grave cases.

The urinary antiseptics, urotropin and salol, are always indicated, to disinfect as much as possible the kidneys and bladder, and free catharsis must be used, to clear out the large intestine.

ACUTE SEPTIC ANURIA

is the most common and from its fatality the most dreaded of all post-operative complications of the genitourinary organs.

No matter how complete the asepsis has been on the part of the surgeon or what efforts have been made to accomplish the impossible and sterilize the urine and genitourinary tract, before the operation, a certain number of patients, particularly old men, will die from this cause.

Probably in every such fatal case the kidneys will be found at autopsy to be the seat of a pyelitis or nephritis, and the arteries to be more or less atheromatous, while in younger men a history of constant alcoholism will be obtained.

The operation may be so slight as passing a catheter on an old man with a large prostate and drawing off a considerable quantity of residual urine, or the condition may follow a more severe procedure, such as an external urethrotomy for stricture, a litholapaxy for stone in the bladder, or a prostatectomy.

The clinical picture is distinct; shortly after an operation, a slight chill and moderate rise of temperature will be noted.

Delirium is present, either dull and muttering or wild and maniacal. The tongue is characteristic and is dry and brown, with fissures. On palpation of the abdomen it is found markedly distended and tympanitic. Even these unfavorable symptoms may subside if the kidney secretion is free, but unfortunately the kidneys are, as a rule, damaged, and, moreover, are afflicted directly by the toxins, and they are unable to eliminate the poison circulating in the blood.

The urinary secretion is always scanty and loaded with pus. Colon bacilli or other organisms are frequently present.

As the case goes on unfavorably, the kidney secretion becomes more and more scanty, the pulse and respirations grow more rapid, and death takes place, apparently from an overwhelming of the entire nervous and eliminative systems by the poison.

The exitus lethalis may be looked for in from four to seven days,

unless an improvement occurs, in which case the kidney secretion is re-established by degrees, the abdomen becomes soft, the delirium improves, and the temperature becomes normal. As long as the kidneys are free from disease septic anuria is a rare postoperative complication, but unfortunately the kidneys become affected in most cases of disease of the bladder and urethra of long standing.

To give a correct prognosis in cases where operation is projected, careful preliminary examinations of the urine may lead us to give a guarded prognosis where kidney disease is found. The recent tests for renal functional activity, *i.e.*, the indigo-carmine test of Völcker and Joseph or the phenolsulphonphthalein test of Young and Geraghty, are of great assistance in showing the cases that are unsuitable for operation. By means of preliminary prophylactic treatment before operation, much can be accomplished to lessen the risk.

A bladder which has been overdistended with residual urine for a long time should never be emptied at one sitting, nor should an immediate prostatectomy be attempted, but the patient should be kept in bed, the bladder gradually emptied, and finally a permanent catheter worn for some days, until the fever has subsided and the patient feels well. The bladder should be irrigated, the bowels kept freely opened to prevent accumulation of colon bacilli, and the kidneys induced to act by insisting on the patient's drinking large quantities of water. The urinary antiseptics, urotropin and salol, are also indicated.

The above treatment is equally called for in cases of stone in the bladder. In stricture, unfortunately, it can only be partially carried out, as it is usually impossible to introduce a catheter to keep the bladder empty.

Treatment of the Attack.—The essential thing is to get the kidneys secreting if possible, and to this end the Murphy drip or normal salt solution delivered drop by drop from an irrigator through a soft-rubber catheter carried high up into the rectum, by which it is absorbed, is the best stimulant for the urinary secretion that we possess.

If the patient is not vomiting everything, water should be freely given by the mouth; if the vomiting is continuous and of a black color, the stomach should be washed.

To control the tympanites eserine and strychnine, of each, gr. $\frac{1}{40}$, should be given by hypodermic every two hours, for 3 doses, and asafetida, in 5-grain pills, may be given every three hours.

If urine is retained in the bladder, as in a case of enlarged prostate, at the beginning of catheter life, the bladder should be kept empty by means of a permanent catheter and washed twice daily with silver-nitrate

solution, 1 : 4000. If the colon bacillus is the active agent in causing the cystitis, colon vaccines should be administered hypodermically.

Any operation wounds should be opened up freely and irrigated frequently.

CARE OF URETHRAL INSTRUMENTS.

All the instruments which are used in the urethra should be perfectly smooth and highly polished, since any roughness upon the surface will abrade the delicate mucous membrane and expose the patient to the dangers of septic absorption and urinary fever. Instruments should also be well lubricated before introduction. Vaselin is most commonly employed, but it has the disadvantage of coating the mucous membrane and preventing its contact with the irrigating solutions used afterward. Any lubricant should be kept in and used from the flexible tubes, which protect it from the air and keep it sterile.

An excellent lubricant is prepared according to the following formula, suggested by Casper:—

℞ Hydrarg. oxycyanide	Grms.	0.246	(gr. iiiss).
Glycerin		20.	(f℥ss).
Tragacanth		3.	(gr. xlvj).
Aq. destillat.		100.	(f℥iij).

This should be put up in tubes and remains sterile.

It is a good lubricant for all urethral instruments, and may be used in preference to glycerin for lubricating the cystoscope before introduction, as it washes off the lamp and window after the cystoscope has entered the bladder.

It is unfortunately impossible to rid the urethra completely of organisms before introducing instruments, but a considerable amount of sterilization can be accomplished by irrigating the urethra with a 1 : 4000 oxycyanide-of-mercury solution before instrumentation. After the operation of passing sounds or using a cystoscope is finished, another irrigation of the urethra and bladder with oxycyanide should also be made. After a cystoscopy it is always useful to irrigate the bladder through a catheter with 1 : 1000 solution of nitrate of silver, to destroy any organisms which may have been accidentally introduced.

With regard to the care of the instruments themselves, several large books have been written on the best ways of sterilizing them, but for everyday practical use in the office or dispensary the following methods, which are at present in use in the genitourinary clinics in Berlin, will be found to meet the requirements:—

Sounds and *urethroscopic tubes* should be kept in a drawer and prevented from knocking against each other, which destroys the polish.

After using, they should be washed in hot water with soap and a brush, and boiled for five minutes in a solution of washing soda (℥iiss to Oij). The soda is added to prevent rusting. Lithotrites, tunneled sounds, urethrotomes, and metal catheters may be treated in the same way. Soft-rubber catheters should be washed off outside and running water allowed to flow through them; but this is not enough for disinfection, and, in order to accomplish this, they must be boiled in plain water afterward.

Cystoscopes cannot be boiled, as the cement holding the lamp in place is destroyed; but, according to Casper, they may be completely sterilized by rubbing for two minutes with two or three cloths wet with tincture of green soap, paying particular attention to the joints about the lamp and prism. They should be rubbed afterward with alcohol ether to remove the green soap.

The movable parts of the catheterizing cystoscope may be boiled for five minutes.

Before using they may be immersed for a few minutes in solution of formalin, 2½ per cent., or in lysol.

Silk-web catheters, urethral or ureteral, after being used in cases which are not very septic, should be rubbed outside with tincture of green soap, to remove the adherent lubricant or secretions, and washed with soap and water. The lumen should be treated by syringing through with oxycyanide of mercury, 1 : 4000, and then hung up all night to drain and dry. In the morning they should be placed in a jar containing a formalin tablet.

The woven-silk catheters which were formerly made were spoiled by boiling, but various improvements in the manufacture now make it possible to boil them twenty or thirty times before they become too soft to use.

Catheters which were used in very septic cases should be sterilized by wrapping each one separately in gauze, and boiling three minutes in a saturated solution of ammonium sulphate, not allowing them to come in contact with each other or the bottom of the vessel. After boiling they should be taken out and laid away to cool off and become hard.

Instead of being boiled in sulphate-of-ammonium solution, they last longer if they are treated by wrapping in gauze separately and placed in the boiler above the level of the water and steamed for five minutes.

In a clinic where many catheters are used, they can be sterilized in quantities, by placing them in the steam sterilizer, which is a part of the outfit of every hospital operating room; after being wrapped in gauze and after steaming they can be laid away, wrapped up in filter-paper and ready for use.

Flexible bougies à boule, after using, should be washed off with soap and water, or rubbed off with benzine or alcohol ether, sterilized by rubbing off with oxycyanide solution, and laid on a cloth for some hours to become thoroughly dry.

They may also be steamed five minutes, but become softened in time.

They should be kept in a jar containing a formalin tablet.

Kollmann's irrigating dilators, after using, are washed off with soap and water and a brush, and steamed in a special steam pot, or boiled for five minutes and then dipped in alcohol to prevent the joints from rusting.

Rubber dilator covers are rubbed off with benzine or alcohol ether to remove the grease, then wrapped in gauze and steamed for five minutes. If placed in the boiler they should be kept above the water level, as boiling softens them.

Glass irrigator nozzles should be boiled and kept immersed in solution of oxycyanide of mercury.

Knives with fine, delicate edges are dulled by boiling, but may be sterilized by placing in alcohol or formalin solution, 2½ per cent.

Whalebone guides are spoiled by boiling or soaking in a solution. After using, they should be rubbed off with benzine or alcohol ether and oxycyanide solution, and kept in a jar containing a formalin tablet.

DISEASES OF THE BLADDER.

CHAPTER XI.

CYSTITIS.

ETIOLOGY.

It is an event of great rarity for a perfectly normal bladder to become the seat of inflammation, while, on the other hand, any non-inflammatory affection of this organ is most apt to become complicated, sooner or later, by the element of germ-infection, with inflammation ensuing.

There are numerous conditions which may act as **predisposing causes** to cystitis, although they may exist indefinitely without actually causing inflammation. The one most frequently met with in practice is the retention of *residual urine,* occurring in cases of stricture and enlarged prostate or resulting from paralysis of the nerve-supply to the bladder, depending upon a fractured spine or a myelitis. Retention of urine in itself cannot cause inflammation so long as the bladder remains free from infection with micro-organisms; but stagnant urine affords an excellent culture medium for the growth and development of germs which may be introduced into the bladder, and the retention of urine, if long continued, impairs the vitality of the mucous membrane by keeping it congested.

Chronic congestion of the mucous membrane may occur without the presence of retained urine, and may be occasioned by calculus, some forms of prostatic enlargement, and in women by pregnancy and menstruation.

The normal epithelium of the bladder offers a barrier to the penetration of micro-organisms so long as its cells are intact; but if the bladder-walls are congested for some time, the superficial cells are loosened and desquamated and the softer cells underneath are exposed, allowing the entrance of germs.

The hyperemia also causes the small blood-vessels to rupture, on account of the increased vascular pressure.

Exposure to cold is often considered an exciting cause of cystitis, but it can only act in an indirect way by lowering the vitality of the tissues, so that germ-infection may the more easily take place.

The various predisposing causes above mentioned cannot in themselves excite inflammation. They operate by preventing the bladder from

being evacuated, and allowing residual urine to accumulate and form a favorable culture-medium for germs, or by producing congestion of the mucous membrane, which lowers its vitality and causes desquamation of its protective cells, thus opening up avenues for infection.

The exciting cause of an attack of cystitis is invariably **micro-organisms.** Normal urine is an aseptic fluid, free from germs, and can be injected into the peritoneal cavity without causing suppuration. In every case of cystitis various forms of cocci and bacteria are always present.

Many of these organisms are incapable of causing cystitis, if they find their way into a normal bladder, which can be completely emptied of its urine, because they are voided along with the urine, without causing any injury to the bladder.

On the other hand, the *Staphylococcus pyogenes* and the *Urobacillus liquefaciens septicus* and virulent cultures of the *Bacillus coli* possess the power of breaking up urea and forming ammonia, and on this account they are able in themselves, without the aid of a favorable predisposing cause, to excite cystitis.

Micro-organisms Found in Cystitis.—C. Mansell Moullin[1] examined the urine from 30 cases of suppurative cystitis, most of which were old men with enlarged prostates. Cases of tubercular and gonorrheal cystitis were excluded, and the following results were obtained:—

The reaction was acid or neutral in 24 and alkaline in 6.

Micro-organisms were present in abundance in all of them.

The *Bacillus coli* was present in 21 of the acid urines and in 4 of the alkaline cases.

Streptococcus pyogenes occurred in 4 acid and 3 alkaline cases.

The *Urobacillus liquefaciens* was present in 5 of the alkaline cases.

In addition, a staphylococcus was present in 8 and a diplococcus in 2.

These examinations show that the *Bacillus coli* is the organism most frequently present in cystitis when the urine is acid, and the *Urobacillus liquefaciens septicus* when it is alkaline.

Bacillus coli in shape is a short bacillus with rounded ends, which is found normally in the intestinal canal. The virulence of its culture depends upon the source from which they are taken, a growth from the contents of the healthy intestine having less virulence than one taken from a case of infantile diarrhea, while a culture from choleraic discharges is virulent in the highest degree.

Unlike other micro-organisms, the *Bacillus coli* has but little effect in causing the urine to become alkaline by decomposing its urea, and the urine retains its acid reaction for a considerable length of time. Although

[1] "Inflammation of the Bladder and Urinary Fever," Blakiston, 1898.

the *Bacillus coli* is a harmless saprophyte in the intestine, it has the effect, when injected into the tissues, of causing an abscess or of inducing toxemia or general septicemia.

The Urobacillus liquefaciens septicus is chiefly of interest from its power of decomposing urea and causing the urine to become alkaline within a few hours.

Cultures of the *Bacillus coli,* if injected into the bladder, often fail to produce cystitis unless a predisposing cause, such as retention of urine or congestion, be present.

If, however, the urobacillus gains admission to the bladder, cystitis almost invariably follows on account of the ammonia which is set free from the decomposed urea and which acts as an exciting cause for the inflammation.

The Streptococcus pyogenes and Staphylococcus pyogenes aureus are both capable of inducing septicemia if they gain entrance into the blood-circulation, and locally they attack the bladder-walls, causing diffuse inflammation with suppuration.

The streptococcus does not decompose urea, and when it is found in alkaline urine the decomposition has been effected through the agency of another micro-organism, which is often the urobacillus.

Experimental and clinical evidence serves to show that, while all cases of ordinary suppurative cystitis are dependent upon these or similar organisms, inflammation of the bladder cannot be induced by their mere introduction into it, so long as the urine can be completely evacuated and its walls are in a healthy condition. The *Urobacillus liquefaciens* alone is capable of exciting cystitis in a normal bladder, through its property of decomposing urea.

If, however, there be residual urine retained in the bladder, behind a stricture or enlarged prostate, or if the bladder-wall is congested and eroded from the irritation of a calculus or the administration of cantharides, cystitis will surely result from the introduction of the other forms of micro-organisms.

Avenues Through which Micro-organisms Reach the Bladder.—Germs may enter the bladder by the following routes:—

I. Through the urethra.

II. They may descend with the urine from the kidneys.

III. They may pass through the blood-circulation direct to the bladder.

IV. They may pass through the lymphatics from adjacent organs.

I. Infection through the Urethra.—As already stated, the *Bacillus coli* is responsible for the larger number of cases of cystitis. Its chief habitat is the intestine, where it is always present, although varying greatly in virulence. It is also usually to be found, but mixed with other

organisms, upon the glans penis, and under the prepuce and in the fossa navicularis, and in women it exists in the meatus urinarius and the folds of the vulva.

The deep urethra in the male probably does not afford a resting place for germs while it is healthy. When, however, it is altered by disease, either stricture or enlargement of the prostate, the dilated pouch, containing stagnant urine and mucus, affords a favorable hibernating place for bacteria.

Cystitis does not occur in men with healthy urethras, except as a result of instrumentation, but in cases of enlarged prostate it is of common occurrence, even when no instruments have been used. In most instances where the bladder is infected from the urethra a catheter or sound is the means by which the germs are introduced.

Although the instrument may have been sterile before introduction, it may have been infected by brushing against the patient's clothing, or acquired germs from contact with the glans penis or meatus, or it may have carried germs along from a pouch behind a stricture or enlarged prostate in the urethra itself.

But, unless the predisposing causes of congestion of the bladder-wall or residual urine be present, the micro-organisms will usually be swept out of the bladder with the first act of urination, without causing any damage.

II. Infection of the Bladder with Bacteria which Descend in the Urine from the Kidneys.—The *Bacillus coli,* which exists in profusion in the intestinal canal, readily makes its way through the wall of the intestine into the blood-circulation, and notably so, if diarrhea or intestinal disease be present. After gaining the blood-circulation the bacilli are eliminated by the kidneys, and passing out with the urine gain entrance to the bladder, and under the existence of favoring conditions, such as congestion or residual urine, cystitis is excited.

III. Infection of the Bladder through the Blood-current.—Infective emboli occurring in the course of some general disease may be carried through the capillaries, and local foci of disease in the bladder may be originated through their agency. This cause of infection, however, seldom occurs except as a result of tuberculosis.

IV. Micro-organisms Formed in an Adjacent Organ May be Carried to the Bladder through the Channel of the Lymphatic Vessels.—This form of infection has been proved experimentally and will serve to explain the occurrence of cystitis in women who are the subjects of salpingitis and endometritis, and in whom the micro-organisms probably pass from the ovaries or uterus to the bladder, through the lymphatics.

CLASSIFICATION.

Cystitis begins acutely, and frequently becomes chronic. Various attempts to group the varieties from an etiological or anatomical standpoint have been made, but for practical uses a division into *simple, suppurative,* and *specific* cystitis serves the purpose.

Under the term **simple cystitis** is understood the inflammation of the bladder which is not caused by germ-infection, but which results from a mechanical cause, such as the irritation from a calculus or crystals in the urine or from a chemical irritation caused by cantharides. Simple cystitis exists as a theoretical condition only, for, as a matter of fact, the complication of *germ-infection* occurs in every case, and in a few hours the bladder becomes infected with micro-organisms, and the simple inflammation is converted into **suppurative cystitis.**

PATHOLOGICAL CHANGES IN THE BLADDER.

Location.—The disease process is most marked in the region of the trigone and particularly so around the ureters and urethral orifice. The fundus is usually nearly or quite normal.

The mucous membrane is the part usually affected, but the inflammation may attack the deeper structures and the muscular, subserous, and even the serous coats may be involved.

In acute cystitis the cystoscope affords a means of studying the changes in the mucous membrane of the bladder. Its color is found to be brilliant scarlet, with branching lines marking the course of the distended vessels, which bleed readily. The surface of the mucous membrane has lost its polish, is ragged and velvety, and has flakes of lymph adhering to it. In severe cases the epithelium is detached, leaving *erosions.*

In very septic cases portions of the mucous membrane slough away, and hang from the walls in shreds, and minute abscesses may form in the submucous coat or among the muscular layers. Micro-organisms are invariably present; the urine is filled with them, and they lie on the surface and between the epithelial cells.

The **pathological changes in chronic cystitis** resemble those of the acute form, but are more marked. The erosions are deeper, sometimes forming actual ulcers. The surface of the mucous membrane is black or slate-colored, from the escape of blood-pigment into the tissues through small capillary ruptures.

In the early stages the muscular coat may undergo a true hypertrophy of its fibers, but, as a rule, the prolonged inflammation and the vascular degeneration lead in time to a condition of fibroid induration

and sclerosis of the bladder-wall. The walls are thicker and denser than normal and their elasticity is entirely lost. As a result of those conditions the cavity of the bladder often becomes so small and contracted that it can only hold a few ounces. The bladder-wall on contracting falls into folds, with spaces between them, from which it is difficult to empty the urine even with a catheter.

In time the spaces become stretched, forming **sac-like dilatations,** which may be as large as the bladder itself.

These sacs are only covered by serous membrane and have no

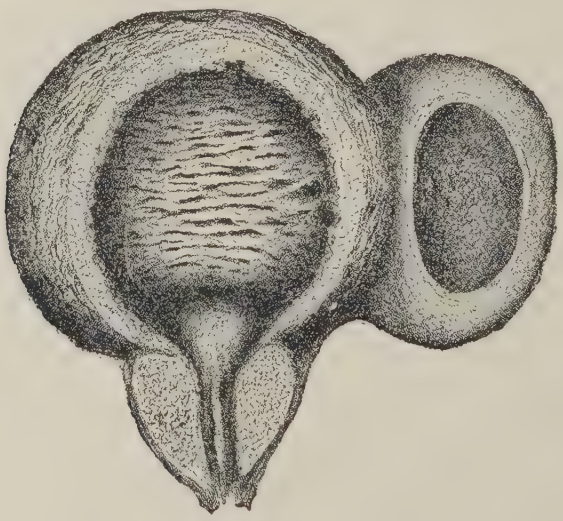

Fig. 111.—Formation of a sacculation in a hypertrophied bladder from prostatic enlargement and prolonged cystitis.

muscular fibers; so that they cannot empty themselves of their contained urine, and, being filled with stagnant decomposing urine, they become a favorite seat for stone formation.

On the other hand, the bladder-walls, instead of being hard and fibrous around a small contracted cavity, may become thin and flaccid, and the cavity may be distended to a capacity of a quart or more.

Membranous Cystitis.—As a result of intense septic infection of the bladder, combined with pressure on its blood-vessels, sufficient to shut off the circulation and cause gangrene, a false membrane may form within the bladder, which is thrown off as a coat of its walls.

The microscope shows these coats to be composed of epithelial cells, lymph, urinary salts, and micro-organisms entangled together.

The slough may make its exit through the urethra, or the whole thickness of the bladder-wall may slough into the cavity of the abdomen.

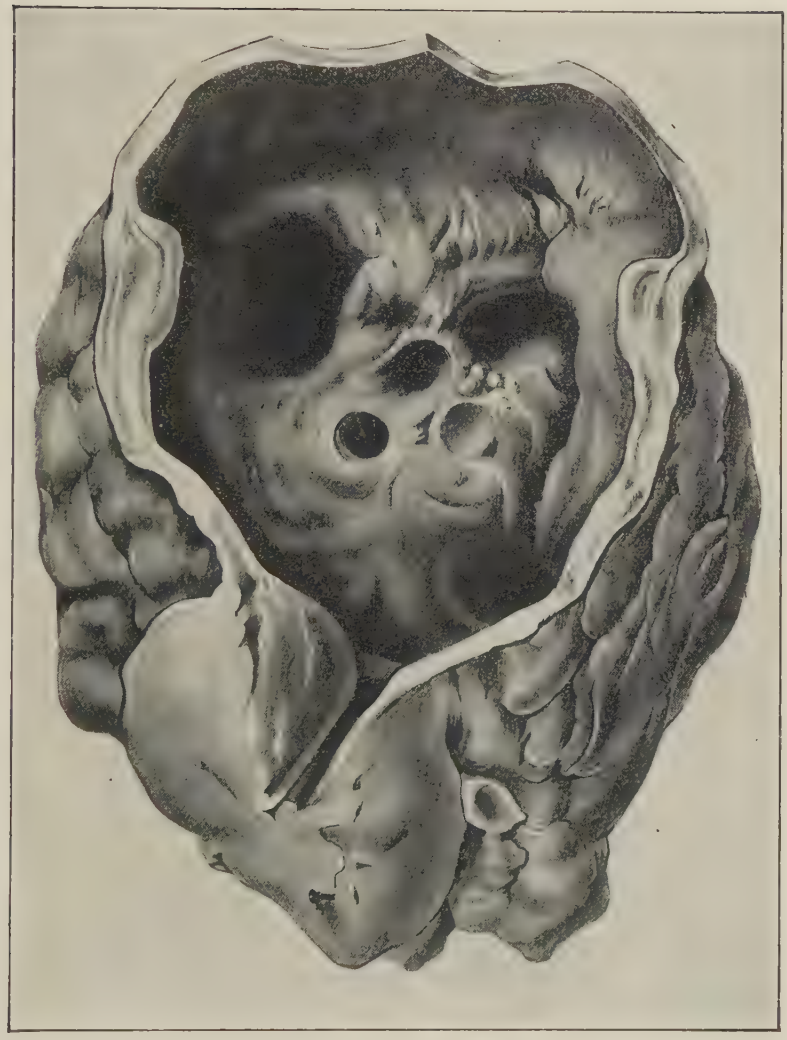

Fig. 112.—Multiple saccular diverticula of bladder.

SYMPTOMS.

Local Symptoms.

I. Frequent Urination.—The inflamed and irritable condition of the bladder-walls and posterior urethra renders the bladder very intolerant of any tension, and after a small quantity of urine collects it is expelled. Prolonged standing or jolting increases the desire to urinate in cystitis and particularly so when the inflammation depends upon a vesical calculus.

II. Painful Urination.—In acute cases the pain is more or less constantly present over the bladder, and is aggravated by the act of urination. As the desire to urinate comes on, the pain increases, and as the bladder contracts the pain may be agonizing, and is felt in the bladder and rectum, and radiates to the end of the penis and down the thighs.

In severe cases there is a desire to urinate every few minutes, and the act of urination is accompanied by great straining or tenesmus.

In the presence of stone or posterior urethritis of gonorrheal origin, the pain is increased after the act of urination, on account of the inflamed walls of the bladder being squeezed together by the muscular contractions. Strangury is noted in the most severe cases only, in which the pain is continuous and where the patient makes violent and straining efforts to urinate and only expels a few drops of blood-stained urine each time.

In chronic cases but little pain is experienced, except in the instances of enlarged prostate, when the bladder is hypertrophied and very much contracted.

III. Pyuria.—Pus in the urine is a constant occurrence in every case of cystitis. If the urine is acid in reaction, the pus appears as a cloud distributed through the urine; but if the reaction is alkaline and ammoniacal, the pus is coagulated and takes the form of a viscid, tenacious, ropy mass, at the bottom of the vessel.

IV. Hematuria.—A slight amount of bleeding occurs from a rupture of the congested capillaries in the bladder-walls, in all cases of cystitis. The blood is always intimately mixed with the urine and disseminated through it. A gush of pure blood following the act of urination is a characteristic sign of inflammation of the posterior urethra.

Constitutional Symptoms.

The constitutional symptoms in cystitis are caused by the toxins which are absorbed into the circulation, and their severity depends upon, first, the amount of the poison absorbed, and, secondly, upon the rapidity of its absorption.

If the bladder is able to empty itself thoroughly, absorption does not take place to any great extent and the constitutional disturbance is not marked.

If, on the other hand, the bladder cannot evacuate itself completely, or if pyogenic organisms have invaded its walls, severe constitutional disturbance follows.

In acute cystitis the bladder can usually empty itself, and the temperature is not high and the constitutional symptoms are not particularly marked; but if, from some cause, obstruction to the outflow of urine exists, and the protecting epithelium has been desquamated from the bladder-wall, an opportunity for the absorption of toxins is afforded and the constitutional symptoms are grave.

This is particularly true in cases of mixed infection, in which the *Bacillus coli* is associated with the *Urobacillus liquefaciens septicus* or *Staphylococcus pyogenes*.

The ammonia which is formed from the decomposed urea helps to break down the protecting layer of bladder epithelium, and the erosions thus formed allow large quantities of toxins to pass rapidly into the blood-circulation.

In old men at the beginning of catheter-life, an asthenic form of cystitis is not uncommon. It is always associated with chronic urinary fever and is often fatal.

In chronic cystitis the constitutional disturbance is slight, because there is very little absorption of toxins from the bladder. Grave symptoms occur only when an acute attack is ingrafted upon a bladder which has suffered with chronic inflammation. Some organism which is capable of decomposing urea enters and ammonia is formed. The tissues, altered by long-continued inflammation, respond violently to the irritant, the kidneys become involved, and septic poisoning follows.

DIAGNOSIS.

The symptoms of frequent urination and pain, when accompanied by turbidity of the urine with pus and occasionally blood, are very characteristic of cystitis. The presence of pus or blood in the urine, however, only signifies that there is a condition of suppuration somewhere along the genitourinary tract. In chronic cases of cystitis it is always important to exclude such local conditions as stricture, stone, or enlarged prostate, and in acute cases the absence of gonorrheal or tubercular infection should be ascertained and the state of the prostate and seminal vesicles should always be examined.

The use of the *cystoscope* is not admissible in acute cases, on account of its increasing the existing irritation, but in chronic cystitis it is indis-

pensable. By its means it is possible to exclude malignant disease and tuberculosis of the bladder and calculus, and the presence or absence of an enlarged and projecting middle lobe of the prostate can be readily ascertained.

Pyelitis can at the same time be diagnosed or excluded, sometimes from the appearance of the ureteral openings, but with absolute certainty by catheterizing the ureters.

The *microscopic* examination is almost as important, to determine the character of the micro-organisms, the variety of the urinary crystals, and the form of the epithelial cells, from which some conclusion as to the involvement of the kidneys may be drawn.

Saccular dilatations can be seen with the cystoscope, but cannot be explored in their depths. For the accurate diagnosis of the shape and location of these diverticula it has been suggested to take radiographs of the bladder after it has been filled with a solution of argyrol or collargol.

PROGNOSIS.

Acute cystitis may heal completely or it may become chronic.

The cure of chronic cystitis depends entirely upon its causation. When it is due to stone, stricture, or enlarged prostate, and its cause can be removed by surgical interference, the prognosis is good.

Chronic cystitis in itself rarely causes death except in the aged and debilitated, who die from absorption of toxins and urinary fever; but, if inflammation of the bladder continues for some time, the infection travels up the ureters, and the kidneys become the seat of disease which ultimately proves fatal.

PREVENTIVE TREATMENT.

Suppurative cystitis is always caused by micro-organisms, of which the most common form is the *Bacillus coli communis,* which originates in the intestine and may make its way into the bladder through the urethra, general blood-circulation, or lymphatics.

Under ordinary conditions the *Bacillus coli* is a harmless saprophyte, but diarrhea, constipation, and other intestinal disorders convert it into an extremely virulent pyogenic germ. Hence it follows that the intestinal canal should be kept as aseptic as possible by means of calomel, purgatives, and intestinal antiseptics. Local foci of infection, where germs can grow in the urethra and around the external genitals of the male and female, should be kept clean and aseptic.

As long as the mucous membrane lining the bladder remains unbroken and the organ is capable of being completely emptied of its contained urine, bacteria may be introduced into the bladder without harm, as they

are soon flushed out by the stream of urine, and cystitis can rarely be induced unless the bladder-wall has been congested and the epithelial lining eroded or it contains residual urine, caused by an enlarged prostate, stricture, or vesical atony. On this account it is important to attend to any local diseased conditions which interfere with its proper emptying, and allow residual urine to accumulate or the bladder-walls to become congested and eroded.

Catheters and sounds must be sterile before using, and the external genitals should always be cleansed before instrumentation (see section on asepsis of instruments).

GENERAL TREATMENT OF ACUTE CYSTITIS.

In all but the mildest cases, the patient should be kept in bed until the severity of the symptoms is controlled and the acute stage is past.

The room should be maintained at an even temperature, for the congestion of an inflamed bladder is notably increased by chilling the surface of the body and by the muscular efforts of walking.

Purgatives.—A brisk calomel purge should always be administered at the beginning of an attack, for the purpose of clearing out the intestine, which is the main source from which the *Bacillus coli* is derived. It has been shown experimentally that rectal obstruction is almost immediately followed by the appearance of enormous numbers of colon bacilli, which come either from the kidneys or directly from the rectum to the bladder through the thin intervening walls. During the progress of the case a daily movement of the bowels should be secured by Hunyadi or Rubinat water.

Hot sitz-baths at a temperature of 100° or 105° F. are serviceable in allaying the vesical irritability and tenesmus. The exposed part of the patient's body should be well covered with blankets while taking them.

The diet should be light and largely composed of milk. Meat should not be allowed at all or only in small quantities. Fresh fruit may be taken in moderation. Alcohol is interdicted unless perhaps in old men who need a stimulant, in which case whisky well diluted may be used.

Diluents.—Pure spring-water or distilled water may be taken freely, unless the desire to urinate is very frequent and urgent. The various infusions of triticum, buchu, etc., probably render the urine bland, simply through the water they contain. Alkalies should never be administered as a routine measure, since in cystitis the urine is frequently alkaline from decomposition of urea into ammonia or from a fixed alkali, and the internal use of alkalies does harm by increasing

the alkalinity. If the urine is highly acid and deposits uric acid crystals, bicarbonate or citrate of potassium is useful in allaying the irritation.

Opium is often required in acute cases to control the vesical tenesmus, pain, and irritability. It is given preferably in ½-grain morphine suppositories, but may be used by the mouth as well. It is unwise to inject morphine into the bladder. If the bladder mucous membrane is unbroken it will not be absorbed, and if erosions are present absorption may occur too quickly and give rise to symptoms of poisoning.

The same holds true of **cocaine**, which has little or no effect in causing local anesthesia of the bladder, as it does in other mucous membranes, and has the great disadvantage of very materially increasing the congestion of the mucous membrane, at times sufficiently to cause retention of urine.

Balsams.—Sandal-wood oil has a very beneficial action in allaying the too frequent urination and pain of cystitis, in its acute stage. Later in the attack, when the secretion of pus has diminished so that the urine, instead of being turbid, presents only a fine cloudiness, the oleoresins, such as turpentine, copaiba, cubebs, fluidextract of pichi, and minute doses of cantharidin dissolved in alcohol, have an effect in quickly causing a cessation of the suppuration and a clearing up of the urine.

Urinary Antiseptics.—Urotropin holds the first place as a germicide in the urine. It does not destroy micro-organisms so much as it prevents their growth and development, and is particularly effective in cases where the urine is alkaline.

The proper dose is 24 grains a day; if this is exceeded, burning in the urethra and frequent urination occur.

The other antiseptics in general use are not nearly as valuable as the one just mentioned, but salol and methyl blue are moderately effective at times.

Salol is given in doses of gr. x three times a day, and acts promptly as a destroyer of micro-organisms, through the constituent carbolic acid, which, from its decomposition, is set free in the urine. In the same way boric and benzoic acids, in doses of 20 grains per day, exercise their germicidal power, and are to be chosen when the urine is alkaline in reaction from the presence of a fixed alkali.

In the group of aniline derivatives may be mentioned methyl blue. Methyl blue, first recommended by Einhorn, in the quantity of 15 grains a day in tablets or capsules, is often of service when the urine contains large quantities of bacteria. The urine, from using this drug, becomes greenish at first in color and later of an intense blue.

Vaccines.—In very recent times some benefit has been derived from the use of vaccines in cases of severe acute cystitis, especially in those due to infection with the colon bacillus.

An autogenous vaccine is to be preferred if it can be obtained. If not, a stock vaccine may be used, and, in connection with other measures, may be of some assistance in controlling the condition.

LOCAL TREATMENT OF ACUTE CYSTITIS.

Bladder-washing, which is so essential in chronic cases, is entirely inadmissible in the acute forms. The only varieties of local application which can be used without doing harm are:—

Instillations of Nitrate of Silver.—These can be used with advantage in the most acute cases of cystitis. The principal indications for their use are painful and frequent urination, provided the bladder is capable of emptying itself. By means of an Ultzmann syringe 20 drops of nitrate-of-silver solution, increasing in strength from gr. j to gr. x, are deposited every second or third day in the posterior urethra, from which point it flows back into the bladder and trickles over the surface of the trigone, which, together with the posterior urethra, are the parts most involved in the inflammatory process. The bladder should be empty, before the instillation, as the nitrate of silver is neutralized if it comes in contact with urine. Instillations are mainly useful in acute cases, although sometimes of service in chronic cystitis.

GENERAL TREATMENT OF CHRONIC CYSTITIS.

After the severe pain and frequent urination of the acute stage have passed off, the urine still contains pus in large quantities and has to be voided more frequently than in the normal condition.

The patient should no longer be confined to bed, but should have the benefit of the fresh air, although much walking is, of course, out of the question for him. He should be instructed to clothe the body in flannel, to wear woolen stockings, and rubber overshoes in damp weather, and cautioned particularly to avoid exposure to a draft or dampness.

The sandal-wood oil is of less use in chronic cases than in the acute, but the oleoresins are of value, and the urinary antiseptics, urotropin and salol, have here their field of greatest usefulness. By means of the general treatment but little can be accomplished, and the main reliance is the local treatment.

LOCAL TREATMENT OF CHRONIC CYSTITIS.

Indications.—I. *Remove any local source of irritation within the bladder or any obstacle to its evacuation.* Palliative measures for the

cure of cystitis are of no avail if a calculus or tumor be allowed to remain within the bladder, or a stricture or enlarged prostate causes residual urine to accumulate.

Indication II. *Remove the urine from the bladder and keep it empty.* In cystitis, if the bladder is able to empty itself completely, the micro-organisms are soon swept away and the attack is over; but if residual urine is allowed to remain and become stagnant, it affords an excellent culture-medium for the growth of the germs.

The simplest form of drainage of the bladder is by means of a soft-rubber catheter passed once a day or oftener, as needed; but in atonic

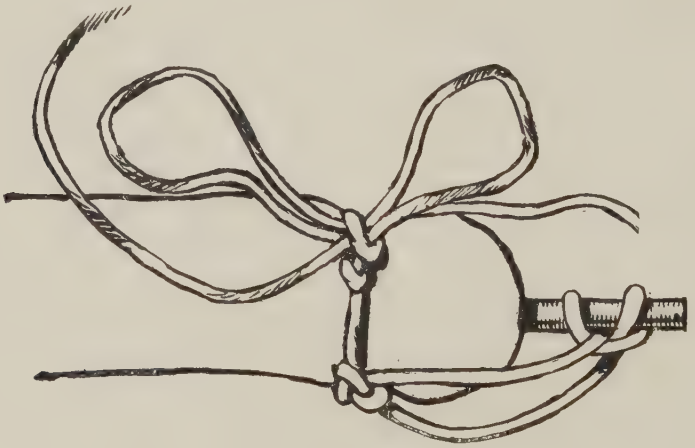

Fig. 113.—Tying catheter in the bladder.

bladders, or severe cases, this is not sufficient and the bladder *must be kept empty.*

Permanent catheterization is an extremely useful and often-employed procedure of the genitourinary surgeon.

It consists in passing a woven-silk catheter into the bladder and tying it so that it cannot be expelled by muscular contraction.

A self-retaining Pezzer or Malecot catheter can be used for the same purpose.

The catheter may lie in the bladder for a week or ten days, or even longer, without causing the slightest harm, except for a light degree of urethritis or, very rarely, epididymitis.

The effects of keeping the bladder empty are followed by an improvement within forty-eight hours, especially in the case of old, feeble men with chronic urinary fever and damaged kidneys who are suffering from toxemia and too feeble to stand the slight operation of perineal section.

The delirium passes; the tongue, instead of being dry and brown, becomes moist, and the appetite and strength return and the local condition of cystitis improves.

Since the practice of preliminary treatment with the permanent catheter before prostatectomy has been generally adopted a distinct lowering in the mortality rate is observed, and cases of postoperative anuria are now seen far less commonly than formerly.

In cases where the catheter is badly tolerated or the patient in his delirium pulls the catheter out, it may be necessary to resort to an incision in the bladder for purposes of drainage.

Perineal Drainage.—Technique of *Operation.*—A lithotomy-staff is introduced into the bladder through the urethra and an incision is made through the perineum, into the membranous urethra, by thrusting a long, straight bistoury an inch and a half in front of the anus, until its point strikes the groove in the staff. A gorget is introduced into the bladder through the wound and a No. 30 French soft-rubber catheter carried along it, till its eye lies within the cavity of the bladder.

A silk suture is then passed through the skin of the perineal wound and the catheter, in this way keeping the catheter from being forced out by the contractions of the bladder.

Instead of a rubber catheter, Watson's silver perineal drainage-tube may be used in cases where the bladder is tolerant; but the metal tube is apt to excite more pain than the soft-rubber catheter.

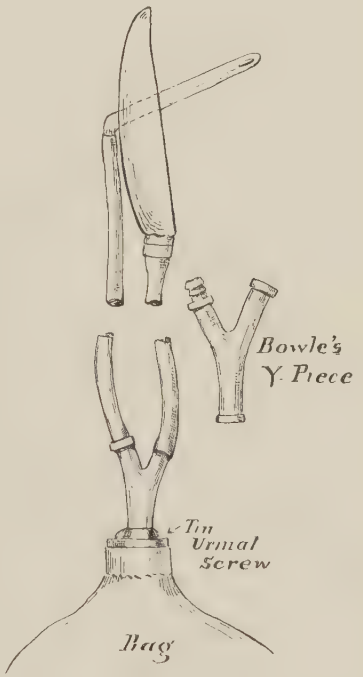

Fig. 114.

The catheter is attached to a rubber tube whose end lies in a bottle on the floor to receive the urine. In this way the bladder is kept entirely empty, and can be thoroughly cleansed by irrigations.

The length of time during which the drainage is to be maintained varies greatly, depending upon the degree of the cystitis. It should be continued until the urine is free from pus and acid in reaction and the muscular walls of the bladder have regained their tone, and this, in a severe case of long standing, may require some months.

Suprapubic drainage is to be preferred to drainage through the perineum, when it is continued for some length of time, as the flow of urine through the abdominal fistula can be received in a rubber bag under the patient's clothing and he can go about and keep dry.

The operative treatment is resorted to only in particularly severe cases, which on account of extreme tenderness make all local means of treatment impossible. Such instances occur in patients with contracted bladders and but little residual urine. They suffer from constant pain

Fig. 115.—Mandril for introducing a Pezzer catheter.

and frequent and painful urination, with the discharge of a few drops of ammoniacal urine each time. Again, in inveterate cases of chronic cystitis, where the bladder is atonic and perhaps sacculated, and where bladder-washing and instillations have been used without effect, permanent drainage through a fistula often causes a marked improvement.

CURETTAGE OF THE BLADDER.

In recent years the fungosities have been removed from the bladder-wall by means of a sharp curette introduced through a perineal or suprapubic incision, and in some cases it has seemed to be of benefit.

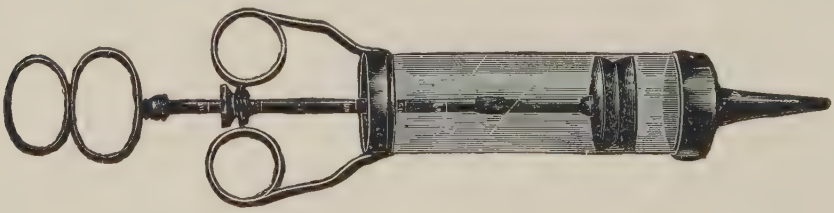

Fig. 116.—Janet-Frank syringe. (Kny-Scherer Company.)

It can readily be performed without any risk at the time the bladder is opened for the purpose of prolonged drainage.

Indication III. *Destroy micro-organisms or check their growth and remove pus and fermentation products from the bladder by means of irrigation of the bladder.* **Washing the bladder** is the most efficient mode of cleansing the bladder-walls of adherent pus, micro-organisms, and urinary salts. The micro-organisms which lie beneath the mucous membrane cannot be reached, but, by lessening the congestion of the mucous membrane and removing decomposed urine, it is put in a condition which favors its recovery.

Although the bladder can be filled by hydrostatic pressure from an irrigator, it requires a catheter to wash it out. The only suitable forms of catheter are the soft rubber and the gum elastic. They should be of large size and provided with two eyes, as the stream flowing through them stirs up the stagnant urine more effectually if it enters the bladder from two directions.

A large glass-and-metal syringe holding five ounces may be used, and has the advantage that it is possible to judge of the extent to which the bladder is filled by the feeling of resistance, to the inflowing stream, offered by the muscular walls of the bladder. The successive jets entering also set up contractions of the muscular walls, which have an influence in restoring their tone, and the introduction of fluid in this manner also forms rapid currents in the bladder which effectually cleanse its walls from adherent pus.

The general custom is to use an *irrigator* raised to the height of two to four feet and attached to the catheter by a short glass connecting-tube. The patient should rest upon a table or sofa in a half-sitting position, and the anterior urethra should be irrigated to cleanse it, before the catheter is carried into the bladder.

As soon as a sense of resistance is perceived or the patient feels pain, the inflow should be stopped, and after a short pause the fluid be allowed to flow out again, and the proceeding repeated until the solution comes away clear. The amount of fluid necessary to flow in at one time is small: 60 to 150 c.c. (from 2 to 5 ounces) is enough.

Reginald Harrison and others state that it is impossible to cleanse the bladder in this way, and strongly advise the piston syringe as the only proper method of bladder-washing.

SOLUTIONS FOR WASHING THE BLADDER.

For simply cleansing the walls of the bladder and removing adherent pus and decomposing urine, normal salt solution, 0.6 per cent., or boric acid water, 4 per cent., in strength, are well adapted to the purpose. Salicylic acid, 3:1000, has some effect in checking the fermentation process.

On account of the bacterial origin of the cystitis, many antiseptics have been recommended, but on more extended trials they have proved disappointing and have fallen into disuse.

Nitrate of silver is an exception to the antiseptics just mentioned, and is the most valuable remedy we possess in suppurative cystitis. It should be used in the strength of 1:4000 up to 1:1000, beginning with the weaker and gradually increasing. The solution should be retained in the bladder two or three minutes and then allowed to flow out again.

If much pain is caused it may be neutralized by washing afterward with salt solution. The application should be made every two to three days. Permanganate of potassium or oxycyanide of mercury is less useful than nitrate of silver in cystitis, but is occasionally of service.

In chronic cystitis, when the bladder is contracted and much pain is complained of, the distention attendant upon washing the bladder contraindicates its use, and instillations of nitrate of silver have to be substituted. Twenty drops may be used every two to four days, from gr. v to x in strength.

SPECIFIC CYSTITIS.

GONORRHEAL CYSTITIS.

Statistics show that the posterior urethra is involved in 80 per cent. of the cases of gonorrhea, but a true cystitis arising from infection of the bladder mucous membrane with gonococci is extremely rare, although a few cases have been recorded.

Inflammation of the trigone of the bladder frequently occurs during the course of a gonorrhea, after the posterior urethra has been attacked, and is almost always due not to the entrance of the gonococci into the bladder, but of some other pathogenic organism, and the infection is therefore of the mixed variety.

Its symptoms, course, and treatment are those of the ordinary forms of suppurative cystitis, and have already been discussed under that heading.

TUBERCULOUS CYSTITIS.

Tubercular involvement of the bladder occurs most frequently in young adults between the ages of 15 and 40, although no age is exempt.

MODES OF INFECTION.

Primary infection of the bladder is of rare occurrence, although it is met with occasionally, for, so long as the vesical epithelium is intact, it affords an efficient barrier to the entrance into the tissues of any tubercle bacilli which may have found their way into the bladder. If the mucous membrane has been injured or eroded by the action of ammoniacal urine, the tubercle bacilli can easily enter the tissues. For this reason primary tuberculosis of the bladder is rare, and when a bladder becomes tuberculous it is usually infected from a deposit elsewhere.

Secondary infection of the bladder may result from the direct extension of a tuberculous infiltration of the seminal vesicles or prostate,

or the bacilli may be conveyed by the lymphatics or blood-circulation from the kidneys or testicle. Most of the cases of bladder tuberculosis, however, originate from the mural transplantation of tubercle bacilli contained in the urine from a tubercular kidney.

PATHOLOGICAL CHANGES.

The tubercular deposit always begins around the vesicourethral orifice and trigone or around the ureteral openings. The process does not last as long as pure tuberculosis, for it is soon complicated by infection with other micro-organisms, causing suppurative cystitis and ammoniacal decomposition of urine.

A *cystoscopic* examination made early in the case shows a few minute papules or pinhead-sized ulcerations, and later in the disease are to be seen irregular-shaped ulcerations covered with a deposit of urinary salts and sloughing material, and the base of the ulcer may be covered with fungating granulations, which bleed easily.

The walls of the bladder in some places become hard and rigid and in others are softened, and its capacity is diminished, so that it may only hold a few ounces of urine. The cellular tissue surrounding the base of the bladder becomes the seat of multiple abscesses, which break and form fistulæ.

SYMPTOMS AND COURSE.

Tuberculosis of the bladder begins insidiously, and often without any apparent cause. Its symptoms are those of cystitis, viz.: frequent urination, pyuria, and hematuria. Bleeding is a prominent symptom, appears early in the disease, and is more or less persistent throughout its course.

In the later stages, after ulceration has made its appearance, the striking symptom is the painful and frequent urination, occasioned by the contraction of the walls of the bladder and the ammoniacal urine coming in contact with its ulcerated walls. The endeavor to rid the bladder of the irritating urine causes straining every few minutes, which is accompanied by intense pain, and the urine contains considerable quantities of blood. The tuberculous foci which first appeared in the kidney have been increasing in size and breaking down, and on operation or *post mortem* the kidney is usually found riddled with abscesses or converted into a pyonephrotic sac.

The septic fever, constant pain, and rapid loss of weight and strength finally, in the course of a variable time, result in the death of the individual, unless the tuberculous focus in the kidney is removed by early operation before involvement of the other kidney.

It is surprising to see the rapidity with which extensive tuberculous ulcerations of the bladder heal after removal of a tuberculous kidney and cessation of the continued entrance into it of pus-cells containing tubercle bacilli.

DIAGNOSIS.

Tuberculosis should always be suspected when a young man of tuberculous heredity develops a cystitis without any apparent exciting or predisposing cause, which runs a very persistent and intractable course, and is not cured by the ordinary treatment.

It may be laid down as a safe rule to follow to suspect tuberculosis of the kidney and bladder in every case of cystitis in young persons which is not due to stone or stricture and does not get well under bladder washing with solution of nitrate of silver.

In fact, the effect of nitrate of silver on a tuberculous bladder is highly diagnostic in itself, for it always increases the pain, tenesmus, and bleeding. When this effect is noted in an apparently mild case of cystitis, close search for tuberculous deposits in the kidney should be made, for too much delay in removal of the infected kidney jeopardizes the patient's life. (See Renal Tuberculosis.)

A *microscopic* examination of the pus from the bladder confirms the diagnosis of tuberculous cystitis by disclosing tubercle bacilli. There may be difficulty in finding the bacilli, even after centrifugating, as they are often scanty. If none are found, the sediment may be injected into the subcutaneous tissue over the abdomen of a guinea-pig. If the animal is killed four weeks later, and the lymph-glands are tubercular or tubercular nodules are disseminated throughout the body, the diagnosis is established.

A careful search should always be made for tubercular foci in neighboring organs, and nodules may usually be found in the prostate, seminal vesicles, or epididymis.

Tubercular involvement of the kidney generally exists and is often overlooked. The symptoms are not marked; there is an absence of renal pain and colic and no tenderness on pressure. It may be suspected, however, when the urine is persistently of a low specific gravity and acid in reaction, and when the pyuria is intermittent in character, and the amount of pus is greater than could be furnished by ulcers in the bladder.

The tests for tuberculin reaction (von Pirquet and Morro) may be tried, but, while very accurate in young children, are not to be depended upon much in adults, and, with the accuracy of the findings with the cystoscope, the presence of tubercle bacilli in the urine, and animal

inoculations, the diagnosis can be positively established without resorting to the reaction tests.

Cystoscopic examination discloses in the early stages a number of pinhead-sized, round, grayish, transparent nodules surrounded by a normal condition of the unaffected mucous membrane. After the destruction of the nodules, they present the appearance of dark-red spots of the size of a pea, and in descending infections are most apt to be located about one ureter mouth.

In more advanced cases the nodules can no longer be seen in the swollen mucous membrane, but generally small multiple ulcers are present.

When the stage of ulceration has been reached, cystoscopic examination is attended with considerable difficulty.

The necessary distention of the bladder with fluid causes free bleeding, which obscures the view, and the local conditions may be made worse by its stretching.

For these reasons it is better only to use the cystoscope when a radical operation is contemplated, for the purpose of accurate diagnosis and separation of the urines.

PROGNOSIS.

The prognosis in tuberculosis of the bladder is not bad in the cases of descending infection, if a nephrectomy is done early enough, and it is most gratifying to observe the improvement in the urinary symptoms and the healing of the ulcers after the constant discharge of pus from the kidney into the bladder has been stopped by the removal of the kidney.

In the cases of involvement of the bladder secondary to tuberculosis of the prostate and vesicles or of the lungs, the outlook is hopeless.

TREATMENT.

The attempt has been made by Guyon, Reverdin, and others to cure vesical tuberculosis in its earliest stages by opening the bladder above the pubes and curetting out the ulcers.

The resort to surgical measures in the beginning of tuberculosis of the bladder in the hope of curing the disease is today practically abandoned. The bladder infection is almost always secondary to tubercular deposits in other organs, most frequently the kidneys, and surgical interference in the majority of cases only increases the rapidity of the course of the disease.

The only rational way of treating tuberculosis of the bladder is to individualize each patient as to whether he is suffering from a descending

infection from the kidneys, a tuberculosis of the prostate and vesicles, or a pulmonary tuberculosis.

The hygienic and dietetic general treatment suitable for all tuberculosis cases is demanded, to assure the cure after operation and to retard the progress in the inoperable cases.

Urotropin is of some value, especially when a mixed infection has taken place. The pain is relieved by morphine, and in the inoperable cases it is the only means which gives the patient any relief from the intolerable pain and tenesmus.

Local treatment is harmful, as a rule. The tubercular deposits cannot be reached, and there is danger, in bladder-washing and instillations, of introducing pus-organisms and causing suppurative cystitis. After this has occurred, the instillation of corrosive sublimate (Guyon), using 20 drops of 1 : 5000 solution and increasing up to 1 : 1000, is often of marked benefit. The reaction following is rather severe, and may last five to six days, and should be allowed to subside before repetition. After the reactive symptoms have passed away, the pain of urination is lessened and the intervals between the acts are prolonged.

Guaiacol, with the addition of iodoform, suspended in olive oil, ½ ounce of which is injected every day into the bladder and allowed to remain in, often controls vesical tenesmus and pain, and enables the patient to hold his water for a longer time, and is one of the best applications for healing the ulcers after a nephrectomy:—

℞ Guaiacol	gr. xxv.
Iodoform	gr. xij.
Olive oil	℥j.

A watery suspension of orthoform, gr. viij to ℥ss, injected into the bladder and held there as long as possible, often relieves the pain for two or three hours.

Nitrate-of-silver instillations are irritating, and aggravate the inflammation. This is so notably the case that a violent reaction following the use of nitrate of silver in a case of cystitis suggests that it is tubercular in origin.

Rovsing[1] has found carbolic acid to be the most efficient local measure for healing the ulcers. After nephrectomy he waits to see if spontaneous cure takes place (occurred in 14 cases, as shown by cystoscopic examination).

In the remaining 25 cases healing did not occur, but the tuberculosis extended, and on these the carbolic acid treatment was used.

The bladder is washed with sterile water and injected with warm

[1] Zeitschrift für Urologie, Band 3, Heft 4.

6 per cent. carbolic acid solution, which is left in two to three minutes. It returns as a milky fluid. The procedure is repeated till the carbolic acid returns clear.

The improvement is rapid, the pus secretion ceases, and the urine becomes clear. The intervals between the washings are increased, as the cystoscope shows ulcers of the mucous membrane covered with smooth mother-of-pearl cicatrices. The time required is from six to eight weeks to effect healing. Two conditions are necessary for healing: first, the origin of the infection must be removed, and, secondly, the tuberculosis must be confined to the mucous membrane and not involve the bladder-wall, and only under these conditions is it proper to apply the treatment.

The objection to the use of carbolic acid is the pain, which can be lessened by injecting novocaine or eucaine into the bladder, followed by an opium suppository or hypodermic of morphine.

Symptoms of carbolic acid poisoning were rarely observed. Rovsing occasionally noted high-colored urine, fainting, and vomiting, but these unpleasant effects soon passed off. In the inoperable cases of bladder tuberculosis, as time goes by, the suffering increases in spite of all local treatment, and even opium in large doses fails to control the tenesmus and frequent urination.

Permanent drainage of the bladder through a fistula should be established. This is not successful in relieving the difficulty entirely, but it is the last resort for the relief of the intense suffering. The suprapubic opening is to be preferred, as the apparatus for receiving the urine can be more easily applied and the patient is not long confined to bed, but can be up and about.

At the time of operation the bladder may be inspected, and if a few isolated tubercular ulcers are found they can be removed with the curette or Paquelin cautery and iodoform rubbed into the spots.

The subsequent healing of the ulcers has a favorable influence upon the pain and tenesmus, and the permanent fistula in the bladder affords an opportunity for the complete and painless evacuation of ammoniacal urine and pus, and also admits of its cavity being kept clean by irrigations, and the congested mucous membrane can also be medicated by instillations of corrosive sublimate or nitrate of silver.

When the bladder cavity is very much contracted and its walls are thick and rigid, suprapubic cystotomy cannot be so readily performed, and permanent drainage through a fistula in the perineum has to be resorted to.

There is always the danger, in establishing an artificial fistula, that the wound itself may be infected and become the seat of a tubercular infiltration, increasing the extent and rapidity of the progress of the

disease. The perineal wound is much more liable to infection than the suprapubic opening, and should only be used when the suprapubic fistula is impracticable.

Tuberculin as a therapeutic measure may be mentioned, but the experiences are too insufficient at present to give any decided opinion as to its usefulness.

BACTERIURIA.

This condition is characterized by the quantities of bacteria which are found growing in the urine, which is entirely free from pus. The mucous membrane of the bladder is perfectly healthy and the infection is confined to the urine alone.

On inspection the urine appears turbid and of a whitish-yellow color, and the odor is very disagreeable, resembling stale fish or feculent material.

On centrifugating and examining the sediment microscopically, it is found to be composed of the *Bacillus coli communis* in enormous quantities. Pus and epithelial cells exist in very small numbers.

It is often impossible to trace the manner in which the bacteria gain access to the bladder, although in most of the cases reported there has been a condition of hematuria, enlargement of the prostate requiring catheterization, stricture, or recent gonorrhea, and in women a recent inflammation of the pelvic organs. It is therefore supposed that the bacteria enter the bladder (*a*) through the urethra, (*b*) with the urine from the kidneys, (*c*) from the general blood-current, or (*d*) from adjacent organs through the lymphatics, although their place of proliferation is not discoverable.

SYMPTOMS.

The symptoms of bacteriuria are not marked, and the turbid urine with a foul odor is often the only sign.

Sometimes the urination is frequent and urgent, and accompanied by a burning pain in the urethra, and rarely a chill followed by fever, which resembles urinary fever in its onset and course, is noted.

COURSE.

The course of the disease is variable, occasionally brief and transient, sometimes more protracted, with remissions alternating with exacerbations, and it often becomes chronic, lasting for years.

PROGNOSIS.

The prognosis is rather unfavorable as regards a cure, unless the place of bacterial growth is accessible. If this is not the case, the bacteria are apt to remain permanently in the urine, but the general health does not suffer and the urinary organs remain in a healthy state.

DIAGNOSIS AND TREATMENT.

The diagnosis can only be made by excluding cystitis and finding the bacteria in the urine with the microscope.

The treatment consists in first removing any possible source of growth for the bacteria by relieving habitual constipation or enteritis. If the breeding-place of the micro-organisms is in some local condition, such as a posterior urethritis or stricture, it should be removed.

When no cause is discoverable, the administration of urinary antiseptics internally—salol, methyl blue, and urotropin—in order to destroy the bacteria, is called for. The patient should drink freely of pure distilled or spring water in order to mechanically wash out and remove the fermenting contents of the bladder.

Bladder-washing with solution of nitrate of silver or sublimate is, in general, of little use, and still at times it may be of some value, and oxycyanide-of-mercury, 1 : 4000, irrigations may also be tried.

TUMORS OF THE BLADDER.

The causation of bladder tumors is unknown, although from their frequent occurrence in aniline-dye workers it would seem as though a chronic irritation of the bladder acted as a predisposing cause.

They are more common in men than in women, and usually appear between the ages of 30 and 40, at which time they are more apt to be benign. After 40 they are usually malignant.

From a clinical standpoint bladder tumors may be divided into two groups: benign papilloma and carcinoma, although the classification cannot always be rigidly adhered to on account of the tendency of the benign growths to be transformed into cancer.

Other forms of tumors, fibroma, myoma, sarcoma, and myxoma, are very rare, but may be found two or three times in a series of 100 cases.

Papilloma may be single or multiple, and attached to the bladder-wall by a pedicle or with a broad, sessile base. It is most commonly met with as a number of tumors growing from a common pedicle, like the branches of a tree from its trunk.

The villi are composed of a fine stroma of connective tissue containing a loop of vessels and covered with several layers of epithelium. When

dry the villi collapse, but in fluid they unfold and float in waving strings. These papillomata may be single, but in 30 to 40 per cent. of the cases (Albarran) they are multiple.

In the large majority of cases they are located on the posterior lateral wall of the bladder, above and to the outer side of one ureter. The

Fig. 117.—Benign papilloma of bladder. Suprapubic cystotomy; tumor grasped with forceps; base burned through with Paquelin cautery. Complete closure of bladder. Primary union. Author's case.

pedicle when drawn on is found to be composed of mucous membrane and blood-vessels, and is thin and often translucent.

The thinness and translucency are clinical signs that the tumor is benign, although the diagnosis can be made positively only by a microscopic examination of the underlying base of the tumor.

It is well established today that a tumor which was originally benign, if allowed to remain without being operated on, becomes transformed into

a carcinoma, and even if a benign tumor is removed surgically if a recurrence takes place the second growth is very likely to be a cancer, instead of the original type of benign papilloma.

Fig. 118.—Benign bladder tumor. Clipping removed by intravesical operation.

Carcinoma of the Bladder

is of more frequent occurrence than the benign papilloma. It may be pedunculated, but is usually seated on a broad base which infiltrates the surrounding tissues.

It is found in two forms: (*a*) As a soft, fungating mass of tumor-tissue projecting into the bladder, which may reach such enormous dimensions as to completely fill the bladder. The fungating masses can be removed with a curette without causing much bleeding, leaving a large, raw ulcer the floor of which is formed by carcinomatous tissue infiltrating the wall of the bladder over a wide area.

This type is very malignant and consists of epithelial cells lying in a delicate connective-tissue stroma, which projects into the cavity of the bladder, and also invades the connective-tissue spaces and lymphatics of its wall.

(*b*) An epitheliomatous ulcer which lies upon the wall of the bladder. The ulcer is small and shows a raised edge surrounding a friable floor covered with phosphatic *débris;* the base is dense and hard. In 70 per cent. of the cases the ulcer is located in the lower third of the bladder and soon involves the trigone.

Fig. 119.—Carcinoma of bladder.

MODE OF EXTENSION.

All bladder tumors, both benign and malignant, may extend to other parts of the bladder by *contact inoculation.*

New growths appear on the bladder-wall at different points which are in contact with the original tumor when the bladder is empty, or a recurrence after operation occurs in the cicatrix in the bladder or suprapubic wound, and is due to transplantation of a few cancer-cells at the time of operation.

Carcinomata spread by infiltrating the surrounding tissues, or the cancer-cells are carried through the lymphatic vessels to the iliac and subsequently the lumbar glands.

SYMPTOMS AND COURSE.

In the beginning there is but little difference in the symptoms between benign and malignant tumors. The most prominent symptom is **hematuria,** which may last for years, gradually increasing in quantity and causing the patient to become markedly anemic and cachectic in appearance.

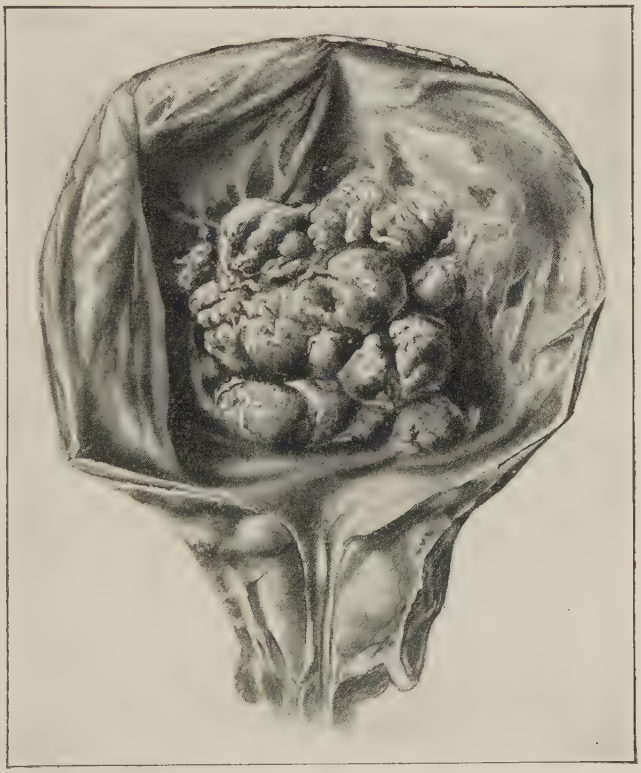

Fig. 120.—Carcinoma of bladder.

The hemorrhage comes on suddenly and without provocation, and may last a few hours or some weeks and then cease, and the urine remains free from blood for a varying length of time, only to be followed by a recurrence of the hemorrhage. The quantity of blood lost is variable and fluctuating, but as the tumor grows larger more blood is lost.

In the early stages the bleeding may be confined to the loss of a few drops after urination, but later it becomes so profuse as to color the urine throughout, or even to form large clots, which cause great distress from the efforts of the bladder to expel them.

The nature of the tumors cannot be determined by the severity of the hemorrhage, for simple polypi often bleed profusely, and a carcinoma may cause but very little hemorrhage.

Caspar states that a tumor which bleeds constantly, hemorrhage being interrupted by the passage of a non-sanguinolent urine for a few days at a time, is nearly always malignant.

Pain and Dysuria.—Pain is a very inconstant symptom. When present in cases of benign papilloma it is due to the cystitis and becomes less as the cystitis improves under treatment.

The disturbances of urination also depend upon the cystitis, and improve or become less severe as the cystitis gets better.

In malignant cases pain may not be noticed until the case is far advanced. Here it is also due to the cystitis and the tenesmus and straining efforts of the bladder to rid itself of the urine.

Pain radiating along the thighs or referred to the anus and perineum is attributed to the pressure of the growth and its metastases upon the nerves supplying these regions.

The *presence of fragments of tissue in the urine* is of considerable diagnostic value, but frequently no pieces are passed.

When portions of the polypi are obtained for examination, the result may be misleading, as it is generally necessary to examine the base of the tumor microscopically to find the carcinomatous infiltration. If only the fimbriated extremities are examined they are found to be composed of loops of blood-vessels, and are not characteristic of the nature of the growth.

Course.—Before the development of cystitis in a case of benign papilloma the only symptom which exists to denote the presence of a bladder tumor is the intermittent hematuria, and unless a cystoscopic examination is made the patient may go on for years with no discomfort. After cystitis is established, however, the quantity of blood lost increases, pain and tenesmus are distressing, interfering with the sleep at night; the anemia from the loss of blood becomes marked, and the patient rapidly grows weaker. If the tumor obstructs the orifice of a ureter or interferes with the outflow of urine from it, hydronephrosis of the corresponding kidney occurs, and is generally followed by infection converting it into a pyonephrosis.

If the tumor grows so large that it nearly fills the cavity of the bladder, a spontaneous breaking off and expulsion of the villi often occur to afford a temporary relief. In other cases the tumor grows so large that the bladder has insufficient room for holding urine, and the frequency of urination is increased, and as a result of increased contractions of the bladder the hemorrhages occur more often.

While a benign papilloma may remain a long time in the bladder without causing much discomfort, it is certain to cause the patient's death eventually, usually by degenerating and becoming transformed into carcinoma. If this does not take place the prolonged loss of blood or pyelitis from ascending infection from the bladder finally causes death.

Malignant tumors run a much more rapid course, the average duration of life being about three years after the onset of symptoms.

The amount of blood lost is less than in benign papillomata, but the attacks of bleeding are more frequent.

The prolonged loss of blood, the broken sleep from the frequent calls to urinate, together with the occurrence of metastases, combine to produce a general enfeeblement and cachexia, which cause death unless the kidney complications mentioned above hasten the fatal termination.

DIAGNOSIS.

A painless hematuria should arouse the practitioner's suspicions at once, and, instead of being treated with drugs and delay, demands **an early cystoscopy.**

The cystoscope has achieved its greatest triumph in the diagnosis of bladder tumors, and in most cases by the use of an irrigating observation cystoscope an experienced observer can wash the bladder so clean that he can obtain a perfect view of its walls and cavity.

In exceptional cases the hemorrhage may be so free that even with an irrigating cystoscope a view cannot be obtained. In such an event the examination must be deferred until the hemorrhage has ceased.

In making the cystoscopic examination, the observer should note the size of the tumor, its location, its shape, whether pedunculated or sessile, whether it presents villi, and whether more than one growth is present.

Palpation by means of one finger in the rectum or vagina and the other hand over the bladder sometimes discloses a tumor infiltrating the wall of the bladder; but if palpation proves negative, we cannot be sure that a tumor is not present, for there may be one so small and superficial that it cannot be felt.

Other methods of diagnosis, such as examination with the Thompson stone searcher or exploratory cystotomy, have now been abandoned since the introduction of the cystoscope.

Other conditions which may give rise to slight hematuria are congestion of the posterior urethra in young men as a result of venereal disease or sexual excesses. In old men it is not infrequently the result of a hypertrophied prostate, alone or complicated by a stone in the post-prostatic pouch.

Malignant disease of one kidney may also give rise to hematuria, the origin of which can be determined by cystoscopy, and in women a urethral caruncle is a frequent cause of hematuria, and is easily excluded.

TREATMENT.

The attempt to remove the tumors by palliative or symptomatic treatment is useless. The **hemorrhage** is sometimes profuse, but never dangerous to life, and usually yields to rest in bed, with an ice-bag over the suprapubic region, light diet, and hydrastis, ergot, or stypticin internally. *Locally,* bladder washing with strong solutions of nitrate of silver is fairly reliable.

Three ounces of 1:1000 or 1:500 nitrate-of-silver solution are injected into the bladder every two days. An eschar is formed over the bleeding area and the vessels plugged. A larger quantity of fluid is not desirable, for it distends the bladder and separates its walls. L. B. Bangs[1] recommends injecting two ounces of creolin solution, ¼ to ½ per cent., which is retained in the bladder from twenty to thirty minutes, and used daily at first and later every second day.

Merck's solution of gelatin, 2 per cent., injected into the bladder and retained, is sometimes useful in stopping the hemorrhage.

If the bleeding persists, a permanent catheter should be used, to stop contractions and put the bladder at rest.

In this way hemorrhage from simple papilloma is always controlled and usually also from malignant disease.

The evacuation of clots is sometimes troublesome, although if of moderate size they soften and pass naturally, but if the bladder becomes greatly distended by clots and urine they may be broken up and washed out through a large catheter, by injecting one or two drams of peroxide of hydrogen through the catheter. This causes a disintegration of the clot, which can be washed out with very hot salt solution and a large syringe, or the clots may be broken up and drawn off by means of a litholapaxy-evacuating tube and aspirator. Sudden distention of the bladder with the fluid should be avoided, for it is liable to cause the bleeding to recommence.

If the bleeding is uncontrollable a suprapubic cystotomy is the last resource.

Cystitis always demands the usual treatment. In the early stages sandal oil and urotropin should be given, and bladder washing not begun until the cystitis has become chronic.

In malignant cases, when no radical removal is attempted, opium is required to relieve the tenesmus. Eventually most of these cases require

[1] Med. Record, Aug. 19, 1911.

a *palliative suprapubic cystotomy* with continuous drainage into a rubber urinal (see chapter on Cystitis). After drainage is established, the tenesmus, straining, and bleeding cease, and the patient has uninterrupted sleep and usually gains in weight.

In this way and with the use of opium as needed, the patient is made comfortable and free from pain for a number of months till death results from hemorrhage, urosepsis, or cachectic exhaustion.

The writer believes that by such a palliative operation in carcinoma we should only open the bladder without attempting to curette or scrape away any part of the growth. A complete removal is usually impossible in an advanced malignant case, and a partial removal only opens up avenues for infection, and the patient dies in a few days after operation from urosepsis, whereas, if the more conservative plan of opening the bladder simply for drainage were adopted, the patient's life would be prolonged several months.

These remarks do not apply, however, to the radical removal of a carcinoma by excision of a part of the bladder-wall, which is considered later, but only to an operation instituted for drainage.

In these inoperable cases the effects of radium might be tried. The remedy is too new and not sufficiently experimented with to know what it can accomplish, but some remarkable instances of arrest of growth or even cure in cases of inoperable cancer in other regions have been reported by observers who are both competent and honest.[1]

Radical Operative Treatment.—The necessity of urging early operation in cases of *benign papilloma* is shown by the fact that if allowed to continue they invariably prove fatal, the patient either dying from hemorrhage after several years or the tumor degenerates and becomes malignant and death results from carcinoma.

The patient's best chance is afforded by early operation and complete removal of the papilloma with an area of the surrounding mucous membrane; even then recurrences follow in perhaps 40 per cent. of the cases, and only 20 per cent. of cures result in the cases of benign papilloma, which are broadly sessile or multiple.

In *malignant cases* the outlook is much worse, for if left alone the patient dies in from three to five years (Keyes), and, if operated upon, the percentage of cures, according to Watson and Cunningham, is only 4 or 5 per cent.

This high mortality will, no doubt, be lowered in time by operating on patients earlier, before the disease has become so extensive and when it can be more easily eradicated. With such a small chance of eradicating the cancer and prolonging life it may be generally more advisable to

[1] Abbe: St. Luke's Hospital Report, 1908-1909.

allow the disease to pursue its natural course for the few months which are allotted to the patient, and make him as comfortable as possible with suprapubic drainage and opium until the exitus lethalis.

Benign tumors may be treated radically by intravesical operations, viz., Nitze's endovesical method; the Oudin high-frequency current.

Certain cases of bladder tumors, where the growths are not very large or very numerous, and where they are located in an accessible part of the bladder, can be removed by using the **Nitze operating cystoscope.**

The tumor is brought into view with the cystoscope, surrounded by the sling, and its base burned through.

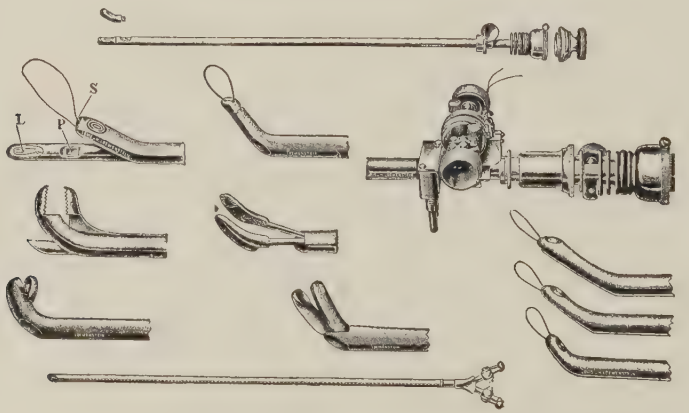

Fig. 121.—Operating cystoscope of Nitze.

The base is subsequently cauterized, using the cautery attached to the cystoscope.

A very considerable amount of experience in the technique of cystoscopy, and particularly in the use of the operating cystoscope, is required to handle the instrument successfully; but by its use it is possible to remove many bladder tumors without making a cutting operation.

Relapses are said to occur less frequently than in the cutting operations. Nitze reports 150 cases of removal of the tumor, with only 20 relapses, which were easily removed by a second intravesical operation.

This method is only adapted to the benign papillomata which can be encircled by the sling. From the infiltration of its base it is impossible to remove a malignant growth, and tearing off small portions from it is not only useless, but harmful, as it opens up channels for infection and urosepsis.

The treatment of bladder tumors by means of the **high-frequency**

or Oudin current was first employed by Beer.[1] This instrument is made by Wappler Bros., and consists in a flexible electrode introduced through a catheterizing cystoscope, and a high-frequency current is applied directly to the tumor, exerting a cauterizing effect upon it and causing it to dry up and drop off into the bladder after several sittings.

In the past year 38 cases have been treated by different genito-urinary surgeons, and in all the benign papillomata the results are said to have been uniformly successful, some cases having been under observation for a year with no evidence of recurrence.

The method has not been used long enough to judge of its value, but it is not unlikely that it may prove to be the solution of the difficult question as to what is the best manner of removing bladder tumors.

Removal by Suprapubic Cystotomy.—It was formerly the custom to remove bladder tumors by perineal incision into the bladder, grasping the projecting tumor with forceps and roughly tearing it off.

Although projecting parts of a tumor could be removed in this way, yet its base was left, and if the tumor was an infiltrating carcinoma after such interference it would grow more rapidly than if left alone.

Even benign papillomata treated in this way were nearly always followed by recurrences, either because the mucous membrane at the base of the tumor was not removed or because some of the cells from the tumor were transplanted into other parts of the bladder at the time of operation.

At the present time the requirements for an operation are not only to remove the tumor, but also the mucous membrane, from its base, and during the operation to avoid brushing off portions of the tumor which can be implanted on other parts of the wall.

At the present time three operations are used for removing bladder tumors by means of a suprapubic incision: (*a*) excision of tumor and portion of mucous membrane of bladder; (*b*) excision of tumor and part of bladder-wall by the intra- or extra- peritoneal method; (*c*) total extirpation of bladder.

The choice of operation depends on the location of the tumor, whether it has a pedicle or whether it arises from an infiltration of the bladder-wall, and whether it is benign or malignant.

A single benign papilloma with a long pedicle presents an ideal case for removal by suprapubic cystotomy, grasping the pedicle with curved forceps and burning it through with the Paquelin, or the pedicle may be drawn tense with forceps and half-inch of the surrounding mucous membrane excised with scissors.

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[1] Jour. Amer. Med. Assoc., May 28, 1910.

To obtain a free exposure of the bladder it is necessary to partially divide transversely, with scissors, the recti muscles.

The bladder may be tightly closed with two layers of catgut sutures, one through the muscular wall and the other a Lembert through the serous coat. The divided ends of the recti should be united, and the abdominal wound closed with a gauze drain in the space of Retzius, and the bladder drained with a Pezzer catheter.

Every patient who is operated on for benign papilloma of the bladder should be treated subsequently by bladder irrigations with resorcin solution, beginning four or five weeks after the wound has healed. A 1 per

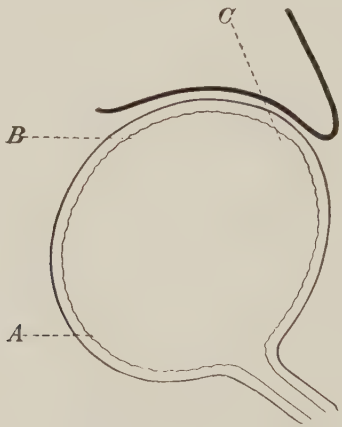

Fig. 122.—Diagrammatic representation of bladder and peritoneal fold.

cent. solution should be used at first, and in the course of several months the strength is increased to 5 per cent. The irrigation should be made twice a week.

It is stated that in this way recurrences can be very largely prevented.

Infiltrating tumors, for practical purposes, may be considered as always malignant, and can only be treated by complete excision of part of the bladder-wall. The success of the operation depends entirely upon the location of the tumor in the bladder.

If the tumor is in region *A* it is a serious question whether operation should be attempted, for it is necessary to do a complete extirpation of the bladder preceded by a double nephrostomy (Watson).

The direct operative mortality is 50 per cent. in these cases, and the chance of cure in those who survive is very slight.

The author believes that the patients will live longer and suffer less if no radical operation is attempted, but only suprapubic drainage employed and the pain relieved by opium.

In a carcinoma located between *A* and *B* it is probably better to go in at once through the peritoneum, as advised by Mayo and Judd.

The patient is placed in the Trendelenberg position, the peritoneum freely incised and the posterior surface of the bladder exposed, and the intestines packed off from the field of operation with gauze sponges or pads.

In this way the tumor can be approached from behind the bladder-wall, and a sufficient portion of the wall excised to take in all the infiltrated tissue.

The bladder cannot be sewed tight enough to prevent all leakage, and it is necessary to depend on tampons for protecting the peritoneum until adhesions have formed.

In cases where the cystoscope does not disclose the true condition, a combination of intra- and extra- peritoneal approach may be necessary for diagnosis and eventual operation. By means of bimanual palpation, with one finger in the space of Retzius or in the bladder and the other finger in the peritoneal cavity behind the bladder, the infiltration of its wall can easily be felt and the proper amount for excision determined.

When the tumor is located higher up in the fundus it becomes more easy of approach. In the case of a tumor in *C-B* the peritoneum can usually be pushed back and the tumor and bladder-wall excised without opening the peritoneum.

CHAPTER XII.

VESICAL CALCULUS.

The stones which are formed in the bladder are classified, according to their composition, into three varieties:—

(*a*) **Uratic calculi,** which are made up of uric acid and urates. They form about three-fifths of the total number of calculi, and are the softest of any in their consistence.

(*b*) **Oxalic calculi** are composed of oxalate of lime. They occur less frequently than the others, the estimated proportion being about 3 per cent. They are the hardest and heaviest of all the varieties, and are usually studded with numerous projecting nodules, from which they derive the name of **mulberry calculi.**

(*c*) **Phosphatic calculi** are formed from phosphates and carbonates, which are often combined with urate of ammonia. Phosphatic stones are not so hard as the oxalic, but harder than the uratic stones. They are never due to constitutional or diathetic conditions, but are always the result of cystitis and decomposing urine, from which the salts are deposited and agglutinated together by the pus.

Stones composed of a single element alone are rarely met with. As a rule, two or more elements are found together, arranged in concentric layers around the nucleus.

The formation of a calculus is not a simple process of a deposit of salts, and it is a common occurrence for urine to contain crystals of uric acid, oxalates, or phosphates for a long time without the formation of a stone; but in the presence of albuminoid material these crystals change their molecular form, gain a tendency to coalesce and adhere to each other; also to a sort of framework composed of colloid material, which is furnished by the pus.

The practical deduction to be drawn from this fact is that, while crystals may be present in the urine for years without the formation of a stone, a cystitis producing pus gives the necessary stimulus to coalescence, and a stone is very liable to form.

NUMBER.

Stones are usually single, although very frequently they are multiple; sometimes five or six may be present, and instances are on record where three or four hundred stones were taken from the bladder.

Fig. 123.—Multiple phosphatic calculi. Suprapubic cystotomy. Author's case.

Fig. 124.—Multiple phosphatic calculi, complicating hypertrophied prostate. Suprapubic cystotomy and prostatectomy. Author's case.

It occasionally happens that a single stone becomes multiple through a process of **spontaneous fracture.**

It has been found in laboratory experiments that, if a calculus formed in a solution of gum were placed in a solution of a different

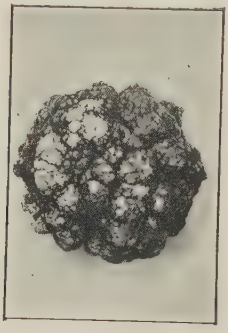

Fig. 125.—Mulberry calculus, removed by suprapubic cystotomy. Author's case.

Fig. 126.—Glass bottle covered with incrustations, removed by perineal section from a male bladder. Author's case.

specific gravity, it would split up into segments. Hence it is probable that the instances reported of the spontaneous fracture of stones in the bladder, which have been accredited to different mineral or spring

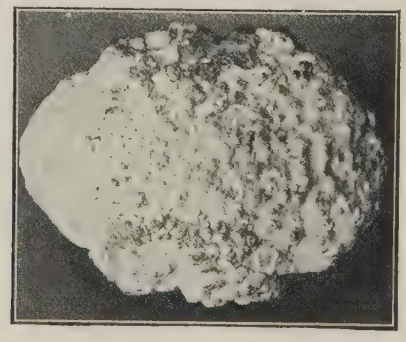

Fig. 127.—Mulberry calculus, removed from boy of 16 years. Author's case.

waters, is due to the effect produced upon the stone by surrounding it with urine whose specific gravity and reaction have been changed from their original state at the time of formation of the stone by the ingestion of large quantities of water. The albuminoid material forming the framework of the stone absorbs fluid and swells, bursting apart the laminæ of the stone and so fracturing it into segments.

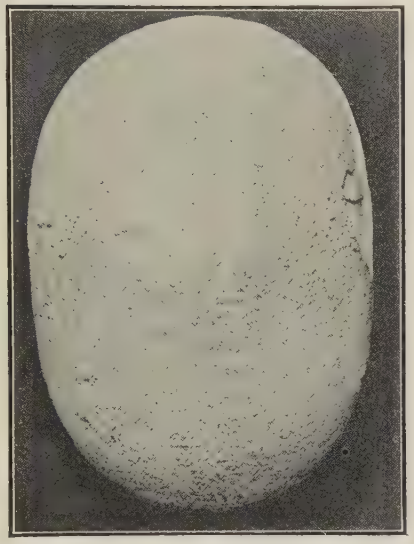

Fig. 128.—Vesical calculus. Weight, 1370 grains. Suprapubic cystotomy. Author's case.

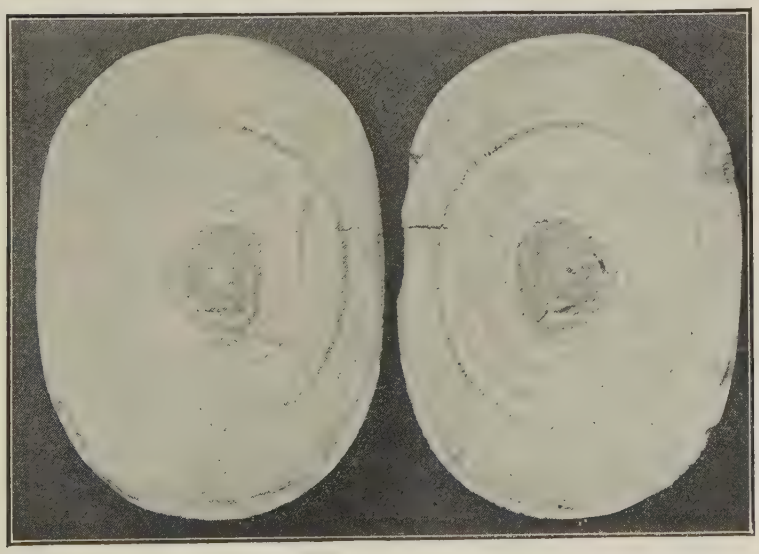

Fig. 129.—Same split in halves, showing mode of formation by a deposit of phosphates in concentric layers around a uric acid nucleus. Author's case.

ETIOLOGY.

For a calculus to form, it is absolutely essential that there should be a foreign body in the bladder, since the crystals must have a *nucleus* around which they may coalesce and adhere.

The nucleus may be a foreign body introduced from without, such as a broken catheter- or pipe- stem, pin, etc., or it may be a small piece of necrotic tissue which has been sloughed off from the bladder-wall.

In many cases of stone, however, the nucleus is composed of uratic crystals. These become agglomerated in the kidney and pass through

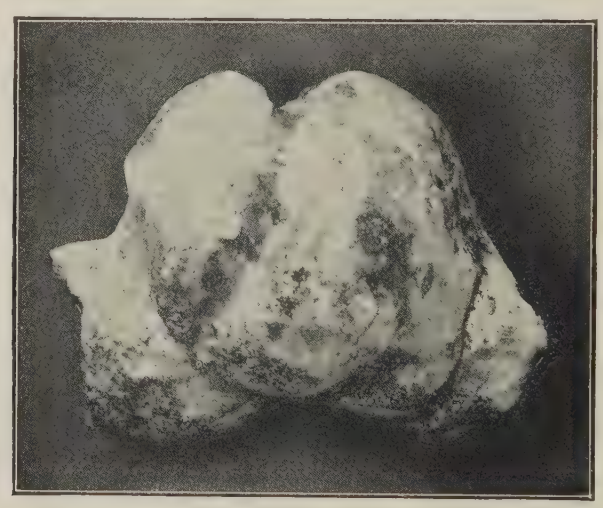

Fig. 130.—Vesical calculus, removed by suprapubic cystotomy. Author's case.

the ureter, causing renal colic. They drop into the bladder, and, if they are not voided through the urethra, form a nucleus.

Predisposing Causes of Uratic and Oxalic Calculi.—As these stones are dependent upon a constitutional or diathetic state, certain things which influence the general condition of bodily health play an important rôle in their formation.

It has been generally supposed that the habitual drinking of water impregnated with the salts of lime was very apt to occasion vesical calculus. Investigations to determine this point show that the cases of calculus are not equally distributed through the limestone districts, and that they are just as common in the adjacent regions where the water is free from lime, and on these accounts the limestone theory has been abandoned.

Diet and constitutional habit, however, are important factors in the production of stone, since the excretion of uric and oxalic acids depends upon the quality of the food and the diathesis. On this account children with feeble digestive powers, who eat largely of nitrogenous food, are unable to perform the processes of oxidation completely, and the results of the retrograde metamorphosis of the tissues are eliminated not as urea, which is freely soluble, but as urates or oxalates.

The same is also true of adults who eat more nitrogenous food than

Fig. 131.—Multiple calculi of bladder, complicating hypertrophied prostate. Suprapubic cystotomy and prostatectomy. Author's case.

they require, use alcohol and malt liquors freely, and take but little exercise. Such persons are subject to attacks of gout or various manifestations of lithemia, which are included under the term of gouty diathesis.

The gouty diathesis is notably an inherited condition, and on that account different members of successive generations of a family are liable to develop oxalic or uratic stone in the bladder or some other gouty manifestation.

Phosphatic stones are not constitutional in their origin, but are dependent upon purely local causes. They result in consequence of urine decomposing and throwing down crystals of the triple phosphates,

which are glued together by mucopus, and form nuclei, around which crystallization goes on rapidly.

On this account any obstruction which prevents the bladder from emptying itself—such as stricture, hypertrophied prostate, and paralysis—allows residual urine to accumulate, and, if cystitis occurs, alkaline fermentation of the urine, deposit of crystals, and stone formation result.

SYMPTOMS.

While it is possible for a small stone to exist for years without producing marked symptoms, and particularly so if it lies in the pouch behind an enlarged prostate, it is usual for a stone in the bladder to give rise to the following prominent symptoms: (*a*) pain, (*b*) increased frequency of urination, (*c*) blood, and (*d*) sudden stoppage of urine in full stream.

The pain is referred to the head of the penis under the glans, and shoots into the perineum and down the thighs.

It is felt especially at the end of urination, for, as the last few drops of urine are expelled, the muscular contractions of the bladder drive the stone forcibly into its neck, causing a contusion.

The pain is increased by riding in a jolting wagon, by going downstairs, or even by walking.

Increased frequency of urination occurs through the day, when the patient is about on his feet and the stone is moving in the bladder. At night, when the individual is quiet in bed, the stone does not move, and the intervals between urination are longer.

Blood never appears in any large quantity in the urine, but a few drops are squeezed out at the end of urination, or it may be mixed with urine, giving a smoky color. It is not a constant symptom, but intermittent.

Sudden stoppage of the urine in full stream is a very characteristic symptom, when it is present, and is caused by the stone being carried into the vesical outlet, obstructing it and shutting off the flow of urine like a valve.

It is rarely observed in old men with enlarged prostates, as the stone lies in the deep posterior prostatic pouch.

Cystitis always exists when a stone is present, and the symptoms of calculus are complicated by those of inflammation of the bladder.

DIAGNOSIS.

The clinical history of stone is merely suggestive of the condition, but to make a positive diagnosis the stone must be touched with an

instrument or through an incision in the bladder or seen with the cystoscope.

Examination with Thompson's Searcher, or Sounding for Stone.—The patient should lie on his back, and with old men it is desirable to elevate the hips so that the stone may roll out of the postprostatic pouch. The bladder should contain from four to six ounces of sterilized water, in order to distend its folds and allow the beak of the searcher to move freely.

The searcher is introduced after the manner of a sound, and the trigone and postprostatic pouch should be examined by turning the beak of the searcher from side to side and rotating it behind the prostate, as the stone always lies in the most dependent portion of the bladder.

If the stone is not touched, the fluid in the bladder should be allowed to flow out through the hollow shaft of the searcher, and, as the bladder

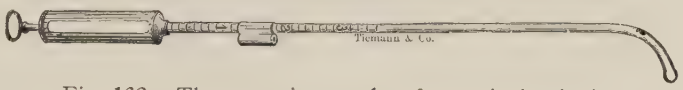

Fig. 132.—Thompson's searcher for vesical calculus.

collapses, the stone is often brought up against the point of the searcher and the impact can be felt.

There are certain precautions to be observed in sounding for stone. The patient's genitals should be cleansed and all the instruments must, of course, be sterile. Children should always be examined under chloroform, as otherwise they would be restless, and the bladder might be wounded by a sudden movement.

In old men there is a great deal of danger of urinary fever. They should be examined at home and kept in bed from twenty-four to forty-eight hours after the examination. It is always desirable to administer salol, gr. v *t. i. d.*, or urotropin, gr. viiss *t. i. d.*, for two days before searching.

If there is a strong suspicion of the presence of a stone, it is advisable to make all the preparations for immediate operation, in order to avoid the reaction which so often follows an examination of the bladder.

The presence of a stone is perceived by the searcher and gives rise to a sharp click, which can be felt and heard. Soft stones give a dull or muffled sound when touched, but the sound is sharper in character when a hard stone is struck.

The size of the stone may be measured by grasping it between the jaws of a lithotrite; but the determination of the *size* or *number* of the stones is difficult with the searcher, and for this purpose the **cystoscope** is of great value.

With this instrument it is possible to see the stones distinctly, unless the bladder is bleeding freely, and their size, shape, and location can all be accurately ascertained.

Phosphatic stones are white and round; uratic stones are yellowish and oval; oxalic concretions are dark and covered with bosses and

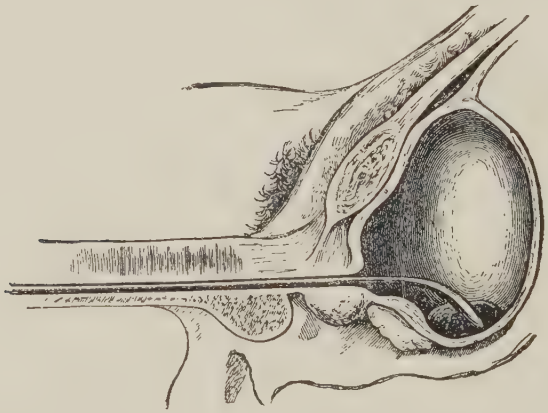

Fig. 133.—Searching for stone lying in the postprostatic pouch.

sharp points; but it should be remembered that most stones are composed of different elements arranged in concentric layers. At the same time the position of the stone may be ascertained, for a stone lying in a deep pouch behind an enlarged prostate, or attached to the bladder-wall as an incrustation, or lying in a saccular dilatation will often be out of reach of a searcher, and may be overlooked.

Fig. 134.—Nitze's observation cystoscope.

An examination of the urine often throws light on the character of the stone by revealing the predominant form of the urinary crystals.

The litholapaxy pump is sometimes useful in detecting a small stone which eludes the searcher. The tube is introduced and water forced into the bladder with the bulb. The outflow of the water forces the stone against the orifice of the tube, and the click is appreciable to the ear and to the touch.

The examination by the X-ray of a stone in the bladder will give a shadow on the plate, but the cystoscope is so much to be preferred that the X-ray examination is rarely necessary.

Since the introduction into practice of the cystoscope the **exploration of the bladder through a suprapubic or perineal wound** is rarely called for.

In former times it was often necessary in doubtful cases, particularly in the instance of a calculus lying in a saccular dilatation or in the presence of an incrustation of the bladder-wall with urinary crystals.

PREVENTIVE TREATMENT.

The presence of crystals in freshly voided urine which is still warm should be regarded as an indication that calculus is liable to form, and the tendency to the formation of *uratic and oxalic stones* should be guarded against by attention to the patient's general health. He should be cautioned against using an excess of nitrogenous food, sugar, or fat. It is in general thought best not to cut off all nitrogenous food, but to allow a general diet, with a reduction of the accustomed quantity of meat.

Moderate and systematic daily exercise in the open air is of great assistance in favoring oxidation.

The ingestion of large quantities of pure spring or distilled water has the effect of diluting concentrated urine, rendering soluble its contained salts, and flushing out the kidneys.

If the urine is strongly acid, citrate of potassium is indicated in order to render it neutral.

If phosphates are abundant and due to imperfect assimilation, the mineral acids, particularly phosphoric, in doses of ♏xv three times a day, and the vegetable bitters improve the digestive powers. The phosphaturia often disappears for a time and sometimes permanently under the use of urotropin, gr. viij three times a day, or benzoic acid.

The adoption of local measures for preventing the formation of **phosphatic calculi** is much oftener crowned with success.

As these stones are always caused by the decomposition of alkaline urine in the presence of cystitis, the indications are (*a*) to drain the bladder by removing a stricture, if present, evacuating residual urine, in cases of enlarged prostate or atony, and distention of the bladder in paralytics, and (*b*) to cure the existing cystitis by bladder-washing.

In this way the decomposition of urine is checked and the precipitation of phosphates and carbonates ceases.

Attempts to dissolve stones after their formation have been made for many years, but, while some have been moderately successful in the laboratory, no method has yet been found which is capable of dissolving a stone in the bladder.

The various waters from mineral springs which have derived some reputation as solvents owe it to the fact, already spoken of, that in a few extremely rare instances *spontaneous fracture* of the stone occurs when the specific gravity of the fluid surrounding it is altered.

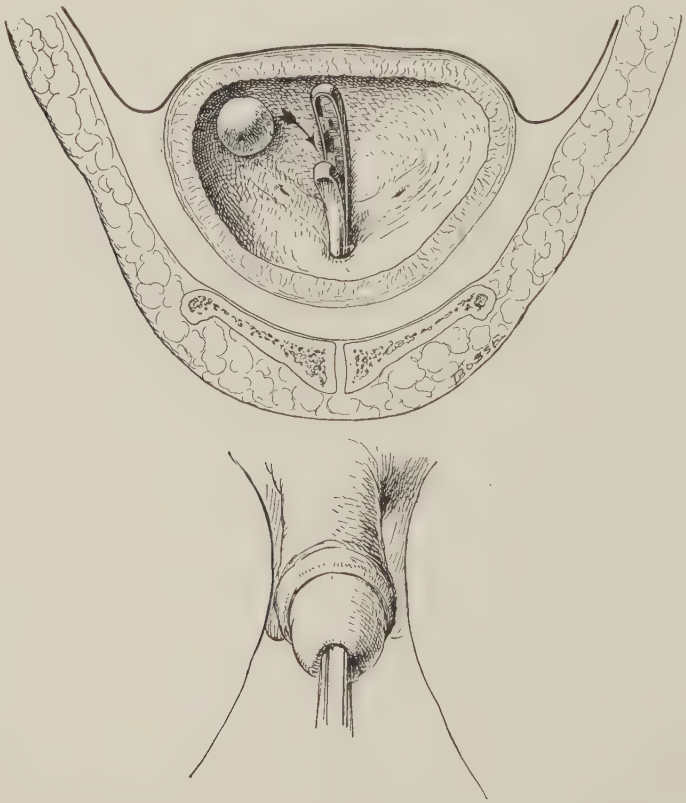

Fig. 135.—The lithotrite is opened in the median region of the bladder, and the calculus rolls between its jaws.

OPERATIVE TREATMENT.

Litholapaxy, or crushing the stone and immediately washing out the fragments from the bladder, is the operation of choice in all cases of vesical calculus.

It is a prerequisite of the operation that: I. The lithotrite and evacuating catheters should be introduced easily and without wounding the urethra or prostate. In children under 16 years of age litholapaxy is regarded by many surgeons as inadmissible on account of the small size of the bladder and urethra.

It is advised, however, by others whenever the urethra is large enough to admit the instruments.

II. The stone must be *movable in the bladder,* of *moderate* size, and *not too hard.*

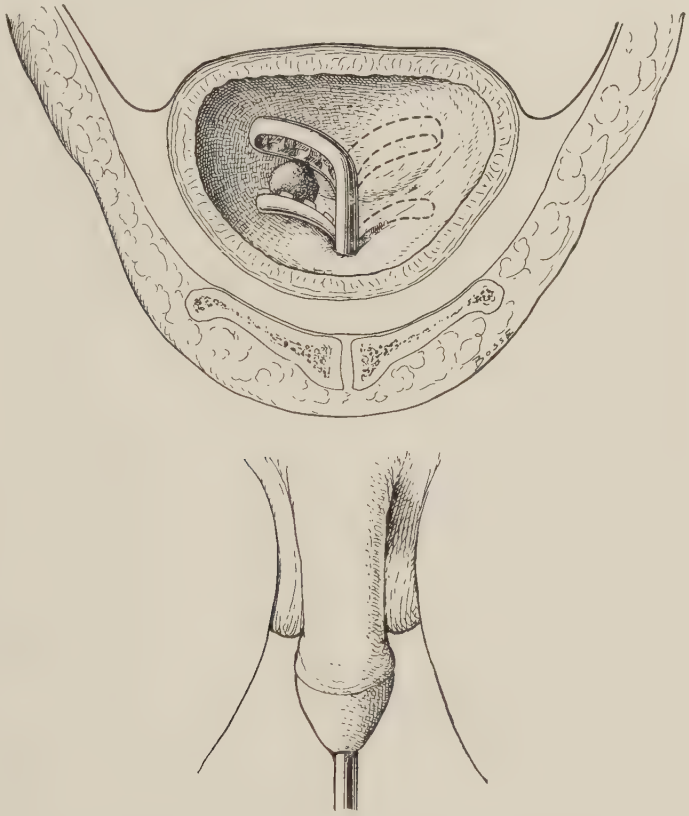

Fig. 136.—Maneuver for grasping the calculus with the lithotrite when it fails to engage between the jaws.

If a stone lies in a saccular dilatation or is adherent to the bladder-wall, it cannot be crushed. Very large stones form such a great quantity of *débris* after crushing that the operation of washing out becomes too protracted.

The *contraindications* to litholapaxy are (*a*) extreme prostatic hypertrophy. The prostate may be so much enlarged that the lithotrite cannot be introduced, or, even if passed into the bladder, it cannot reach and grasp the stone as it lies in the postprostatic pouch.

(*b*) Tight stricture of the deep urethra. Such a narrowing of the urethra will prevent the passage of the instruments, and requires external urethrotomy for its cure, and, at the same time, the stone may be removed through the perineal wound, although if very large it may have to be crushed with a lithotrite first.

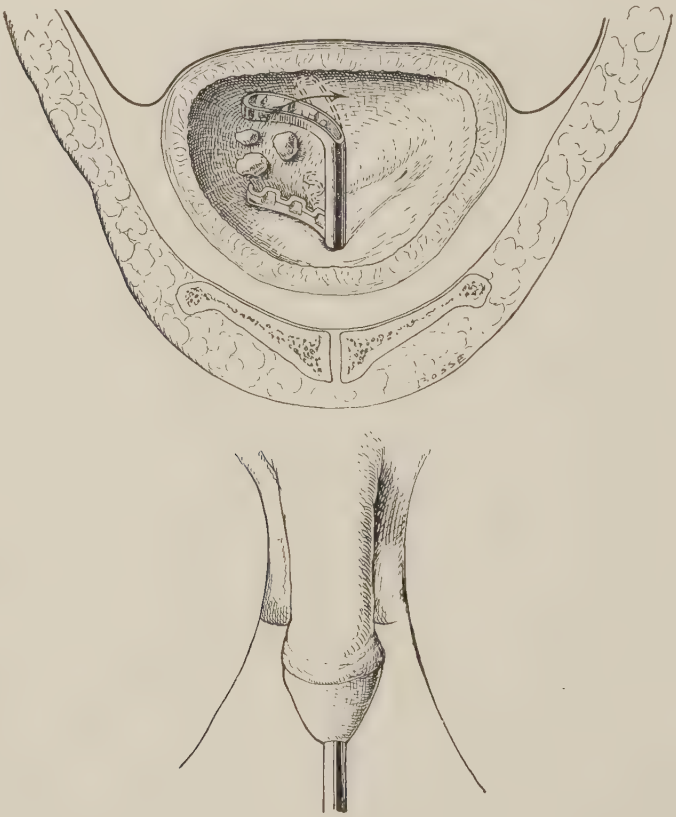

Fig. 137.—Maneuver for grasping fragments in intimate contact with posterior wall.

(*c*) Severe cystitis which does not yield to ordinary treatment. In this condition it is better to remove the stone through an incision, which will subsequently serve for the prolonged drainage of the bladder and at the same time afford an opportunity for its irrigation.

(*d*) Contracted and irritable bladder does not admit of sufficient distention, and is too intolerant of instruments to allow the stone to be crushed.

(*e*) Nephritis and suppurative pyelitis, since uremic coma and death follow litholapaxy, when the kidneys are diseased, more frequently than after the cutting operations.

Technique.—The patient, with his rectum previously emptied, is anesthetized, lying upon his back. The hips are elevated by a cushion

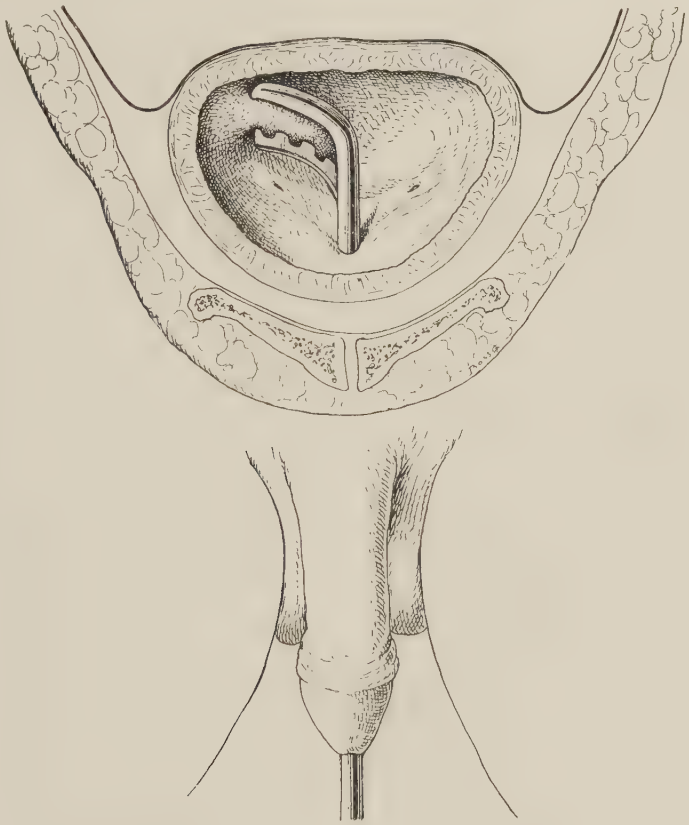

Fig. 138.—Accidental grasping of mucous membrane of bladder between jaws.

placed under the buttocks, to allow the stone to roll out of the post-prostatic pouch.

The bladder is washed out and filled with six to eight ounces of boric acid solution or oxycyanide-of-mercury solution.

The lithotrite is passed through the urethra after the manner of a sound, and rests on the floor of the bladder behind the prostate, with its beak pointing upward. The lithotrite, from its weight, sinks in and forms a depression in the wall of the bladder. Ordinarily the stone lies

along the beak of the lithotrite, and when the jaws are opened it rolls in between them. This manipulation is facilitated by giving the patient's pelvis a couple of shakes, thus causing the stone to roll in the bladder. The jaws are closed and the stone is felt to be grasped. If the jaws fail to seize the stone, the blades are opened in the upright position, turned

Fig. 139.—Bigelow's lithotrite.

over on one side, and shut along the floor of the bladder. If the stone is not found, the maneuver is repeated in the opposite direction.

If the stone lies in a deep postprostatic pouch, raising the patient's hips may roll it out within reach, or it may be pried up by a finger in the rectum.

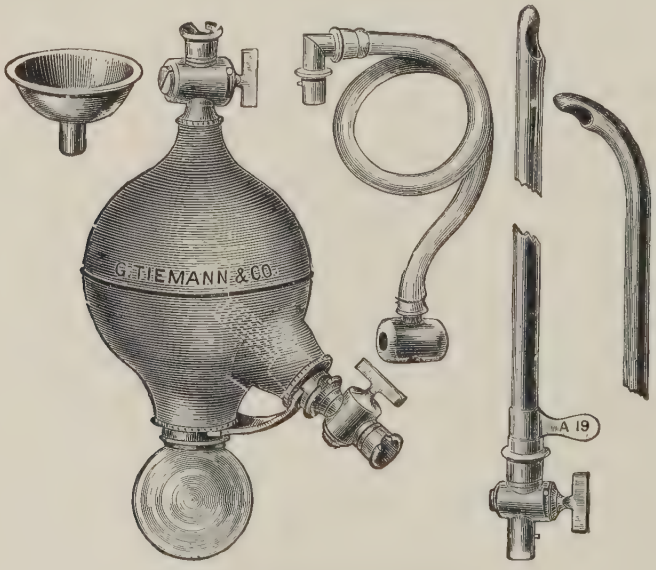

Fig. 140.—Bigelow's evacuator.

In the event of these failing, the jaws of the lithotrite may be turned so as to point downward, in the hope of seizing the stone as it lies; but in this case there is always danger of nipping and cutting out a piece of the bladder-wall.

When the stone has been caught between the jaws, the resistance it offers is easily felt on approximating them. The blades of the lithotrite

are then locked, and by turning the handle the jaws are screwed together, comminuting the stone into fragments. The maneuvers of opening the jaws, catching the stone, and breaking it are repeated until the surgeon perceives that no large fragments are left, and the lithotrite is withdrawn.

The next step is the *evacuation of the débris*. The evacuating tube is introduced into the bladder and its contained fluid allowed to flow out with a gush, carrying with it some of the fragments. The bladder is then filled with water by pumping in the contents of the bulb, and the fluid then flows out again into the receiver, carrying more fragments. The pumping is continued till no more fragments come away, and auscultation over the bladder fails to perceive the click of a fragment remaining behind which is too large to enter the tube. If this is the case the lithotrite should be introduced again and the piece crushed and pumped out.

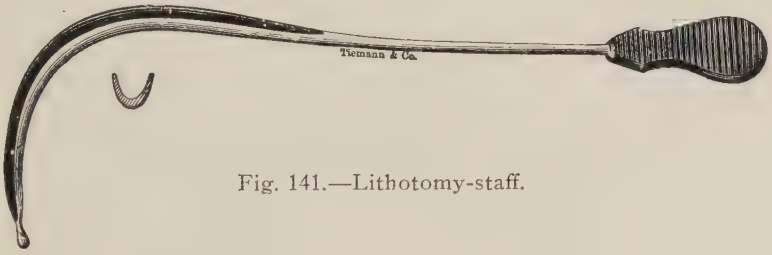

Fig. 141.—Lithotomy-staff.

The after-treatment consists in keeping the patient in bed and allowing him to drink freely of water, to keep the kidneys active.

If retention of urine occurs, it is well to tie a catheter in, in order to avoid the irritation of its frequent passage.

After ten days have passed the bladder should be pumped once more to remove the sand and mucus which are left and which might serve as a nucleus for another stone, and the entire absence of fragments should be verified by a cystoscopic examination.

Mortality of Litholapaxy.—The following statistics, compiled by Cabot, show the death rate at different times of life:—

Children, under 14,	214	cases,	with	4	deaths	= 1.66	per	cent.
Adults, 14 to 50,	400	"	"	13	"	= 3.25	"	"
Old men,	433	"	"	26	"	= 6	"	"

Perineal Lithotomy.—Until within a few years, and before the technique of litholapaxy and suprapubic lithotomy was perfected, the only way of removing a stone was through a perineal incision.

As these methods came into general use, the perineal operation was to some extent abandoned, except in children; but when a cutting operation is required, perineal lithotomy possesses the advantage of causing

less shock than the suprapubic operation, and is well adapted to the removal of small stones and for certain complications which are described below.

Perineal lithotomy offers the advantage of good drainage for the bladder; but if an attempt is made to remove a large stone through the

Fig. 142.—Lithotomy-knife.

perineal wound, the bruising and laceration of the tissues often lead to infection and sloughing.

In addition, a large stone requires such an extensive lateral incision through the prostate that many blood-vessels are divided and hemorrhage may be difficult to control.

Perineal lithotomy has always been considered a dangerous operation

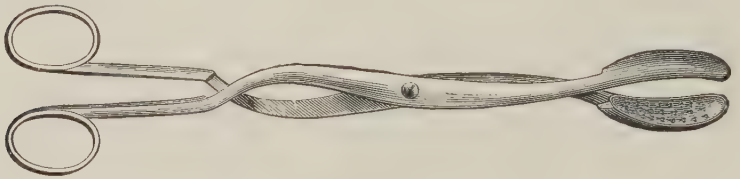

Fig. 143.—Lithotomy-forceps.

in the case of old men with enlarged prostates, on account of the bruising and laceration to which the prostate is subjected while the stone is being withdrawn.

Hypertrophy of the prostate adds very much to the difficulty of reaching a stone from the perineum, on account of the increase of the perineal distance.

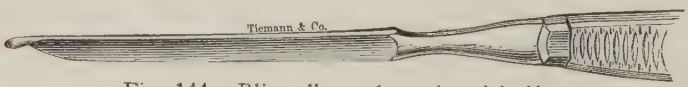

Fig. 144.—Blizard's probe-pointed knife.

At the present time the feeling is that, when dealing with a stone complicated by enlarged prostate, it is safer to enucleate the prostate first, through the perineal incision, and then afterward, as the bladder has settled down, the stone can be reached and removed with but little difficulty, or the calculus and hypertrophied prostate may be removed through a suprapubic incision into the bladder.

If the stone be too large to extract through the perineal incision, Harrison's lithoclast may be used to break it up into fragments, which can be readily brought out through the wound.

The indications for **median perineal lithotomy** may be tabulated as follows:—

(*a*) Small stones of not more than 1¼ inches in diameter, complicated by stricture of the urethra, which demands external urethrotomy.

(*b*) Small stones in the presence of atony of the bladder with no expulsive power, and chronic cystitis, provided that the prostate is not very much enlarged.

(*c*) Contracted and irritable bladder, which does not admit of sufficient distention for suprapubic cystotomy and is too intolerant to allow litholapaxy.

(*d*) Small or moderate-sized stones, complicated by senile hyper-

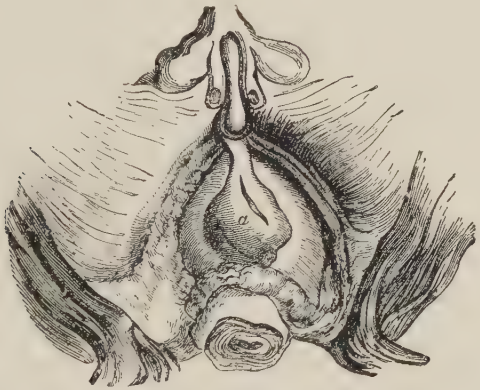

Fig. 145.—Incision through the urethra and prostate in lateral lithotomy.

trophy of the prostate, which is suitable for the operation of perineal prostatectomy.

Perineal Lithotrity.—Reginald Harrison has enlarged the scope of median lithotomy by devising a lithotrite which is introduced through a median incision and by which stones of considerable size can be crushed in the bladder and removed through the perineal wound.

Perineal Lithotomy.—Technique.—(a) Median Operation.—An incision is made in the median line, which is simply a *boutonnière,* or external urethrotomy, and is performed by introducing a grooved lithotomy-staff through the urethra into the bladder.

The staff is held steadily by an assistant and the surgeon makes a direct thrust or stab with a long, straight bistoury, an inch and a half in front of the rectum, through the tissues lying in front of the urethra, and strikes the groove in the staff. A gorget is then slid along the groove until it enters the bladder, which is explored by means of the finger. If

a stone is found, it is grasped by the stone forceps and withdrawn, if not too large.

If the stone proves too large to pass through the wound, (*b*) *perineal lithotrity* may be performed by introducing Harrison's lithotrite, crushing the stone, and either extracting or pumping out the fragments with a litholapaxy evacuator.

The operation may, if desired, be converted into (*c*) *lateral perineal lithotomy*, which was the operation formerly used exclusively in all cases of stone. A Blizard knife is slid along the groove in the staff, as it rests in the bladder, until the point of the knife has entered the bladder. The knife is then withdrawn, making a sweeping cut, outward, downward, and a little to the left, enlarging the original median incision and cutting through the left lobe of the prostate, the perineal muscles, and the skin.

In this way the incision is made of sufficient size to permit the extraction of large stones with the forceps or scoop; but, on account of

Fig. 146.—Lithotomy-scoop.

the drawbacks of hemorrhage and laceration of the tissues, this form of lithotomy is rarely used at the present time, for a stone large enough to require such an extensive incision is best removed by a suprapubic cystotomy.

After-treatment of Perineal Lithotomy.—The wound is never sewed, but is left to heal by granulation. Hemorrhage is inconsiderable after the median operation, and is easily controlled by a gauze packing around a large soft-rubber catheter. It is often very severe after a lateral lithotomy, and often requires the use of the shirted cannula to hold it in check.

The *mortality of perineal lithotomy* has been tabulated by Freyer and Rosenthal, as follows:—

Deaths before the 20th year	5	to 8	per cent.
" in adults	10	" 15	" "
" above the 40th year	32	" 39	" "

These figures refer, in the main, to the operation of lateral lithotomy, and apply less to median lithotomy or lithotrity.

Suprapubic Lithotomy.—Suprapubic lithotomy was first performed in the year 1550 by Pierre Franco, but did not gain favor until 1880, when the application of aseptic methods and improvements in the technique of the operation reduced the previously high rate of mortality.

At the present time, in the cases where litholapaxy cannot be applied and a cutting operation must be employed, suprapubic lithotomy is the operation of choice in dealing with stones over 1½ inches in diameter.

The *advantages* of suprapubic over perineal lithotomy are:—

(*a*) The suprapubic operation admits of complete inspection and evacuation of the bladder.

(*b*) Wounding the ejaculatory ducts, neck of the bladder, and rectum, and dangerous hemorrhage from incised blood-vessels are avoided.

(*c*) The laceration and bruising of the tissues, which occur when a *large* stone is dragged through a perineal wound, are avoided.

(*d*) The bladder is rendered easy of access, while in the presence of a considerable degree of prostatic hypertrophy the perineal distance is so much increased that it may be impossible to reach the bladder from below.

The *disadvantages* are:—

(*a*) A much greater degree of shock and prostration following the operation than exists after perineal lithotomy.

(*b*) The difficulty of keeping the patient's bed and dressings from being soaked with urine, which escapes from the suprapubic wound.

The special indications for suprapubic lithotomy have been tabulated as follows:—

(*a*) Very large stones, even though they be soft. (*b*) Large hard stones. (*c*) All fixed stones, incrustations of the bladder-wall, sacculated stones, etc. (*d*) Cases where a high degree of prostatic hypertrophy exists which prevents the seizure of the stone by the lithotrite.

The technique of the operation is based upon the anatomical fact that, when the bladder is filled, the fold of peritoneum, which lies in front of it, is raised up two inches above the pubes, leaving a space, called the space of Retzius or prevesical space, *uncovered* by *peritoneum*, through which the bladder-wall may be safely incised.

Technique.—The India-rubber bag which was used in the earlier operations for distending the rectum, and so bringing the bladder nearer to the abdominal wall, is rarely, if ever, employed at present. The Trendelenberg position is of great aid in preventing the intestines from being wounded.

A catheter is introduced through the urethra and the bladder is filled with from eight to twelve ounces of sterilized water, by means of a syringe. Helferich and Bristow use air for this purpose.

The catheter is withdrawn and a rubber band is tied around the root of the penis.

An incision is made in the median line of the abdomen, beginning three inches above the pubes and extending down over it, which divides

the skin and subcutaneous fat. There is no linea alba in this region and the incision is carried directly through the muscular bundles, and the transversalis fascia is divided. The edges of the wound are held apart by large angular retractors and the bladder appears lying at the bottom of the wound. It is recognized by its shape and by the prevesical fat, which is adherent to it. If any doubt exists, it may be punctured with an exploring hypodermic syringe.

In old men the peritoneal fold in front of the bladder is sometimes unusually long, and extends down low, into the space of Retzius. In

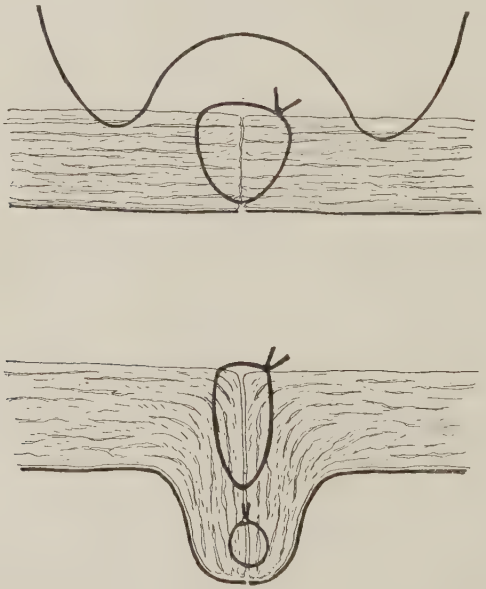

Fig. 147.—Suturing the bladder in two layers. First row includes muscular coat, but not the mucous membrane; second row includes the serous covering of the bladder and buries the first row.

such a case it should be peeled up from the bladder and held out of the way. If the peritoneum is accidentally wounded, it should be at once sewed up with fine silk.

After the bladder is exposed, it should be steadied with a sharp hook, thrust through its wall at the upper angle of the wound, and two long silk retraction sutures are passed through the bladder-walls, at the sides of the wound.

These are held by an assistant and the bladder is opened between them by means of a scalpel. As the water in the bladder is flowing out, the incision may be enlarged to the desired extent by means of a straight, blunt-pointed bistoury.

The cavity of the bladder is then searched with the finger, and the stone removed with a lithotomy-scoop or forceps. If it is desired to inspect the interior of the bladder, its walls may be distended by Watson's bladder speculum and the cavity illuminated by Pilcher's electric lamp or a head-mirror and reflected light. A thorough exploration of the interior of the bladder can best be obtained by dividing a portion of each rectus muscle transversely, and by inserting three right-angled retractors, two at the sides and one at the upper angle of the incision into the cavity of the bladder. This extensive exposure is not called for in an uncomplicated case of stone, but only where a bladder tumor is present as a complication.

The period of wound healing is very much shortened by sewing the bladder at the completion of the operation, and it may be closed completely in young and middle-aged persons when only a moderate degree

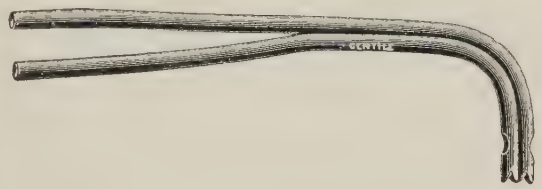

Fig. 148.—Guyon double tube for drainage of the bladder after suprapubic cystotomy.

of cystitis is present. The bladder should be sewed with two rows of catgut sutures; the first row includes the muscular wall and brings the mucous membrane close together, and the second row is a sort of Lembert, bringing the serous coats in contact and burying completely the first row.

Drainage of the bladder should be provided for by laying in a Pezzer catheter, but, as a certain amount of leakage of urine is very liable to occur, the space of Retzius should always be packed with gauze and the lower angle of the wound left open after the recti muscles and skin have been sutured.

In old men and in the presence of severe suppurative cystitis and ammoniacal urine it is always safer to provide for drainage of the bladder by introducing a Freyer or Guyon tube into its cavity through the abdominal incision and suturing the bladder and abdominal wall around the tube with gauze drainage in the space of Retzius.

The length of time required for the healing of the wound is from two to three weeks when the bladder is sutured, and from three to six weeks when the wound is left to heal by granulation.

The *mortality statistics* of suprapubic lithotomy collected by Cabot show the following results:—

Age.	Cases.	Deaths.	Percentage.
Adults, 14 to 50 years	100	12	12
Old men	53	17	32

OPERATIONS FOR CALCULUS IN CHILDREN.

Perineal Lithotomy.—The median operation is impracticable in children, on account of the difficulty in withdrawing a stone through the small posterior urethra. For the same reason Harrison's lithotrite cannot be used. The lateral operation, however, can be readily performed with much greater safety than in adults, for, as the prostate and urethra grow larger, they become more vascular, and the danger of hemorrhage increases.

The lateral operation has a drawback in the danger of wounding the ejaculatory seminal duct and producing sterility on that side, in after-life. The mortality is about 3 per cent., and lateral lithotomy is still generally considered to be the operation of choice in the case of small stones in children.

Litholapaxy in children is attended with some difficulties, on account of the small size of the urethra interfering with the introduction of the lithotrite and the relative hardness of the stones, as met with. In spite of this it has been performed a great many times, and the death rate is low: only about 3 per cent. As far as the death rate is concerned, there is but little choice between lateral lithotomy and litholapaxy.

Suprapubic cystotomy in children is more dangerous, according to the collected statistics, than either of the other operations, the mortality being about 10 per cent., although stones one and one-quarter inches in diameter or over are considered too large for lateral lithotomy and must be removed through a suprapubic incision.

The size of a stone is readily estimated in children by the bimanual examination with one finger in the rectum and the other hand over the bladder.

BILHARZIA HÆMATOBIA[1]

is a disease occurring in South Africa, Egypt, and along the Nile, and is caused by a parasitic worm, which is taken into the human organism through the legs or directly up the urethra when bathing.

The adult worms develop in the portal veins, taking from three to six months to attain maturity, from which they make their way to the

[1] Kidd: "Urinary Surgery," London, 1910.

pelvic veins, and, having anchored in the bladder-walls, proceed to hatch out brood after brood of eggs. They usually live for three or four years, and if the infected person leaves the country he may expect the parasites to die out in about four years' time, but the symptoms usually disappear before that.

The characteristic symptom is the passage of a few drops of blood

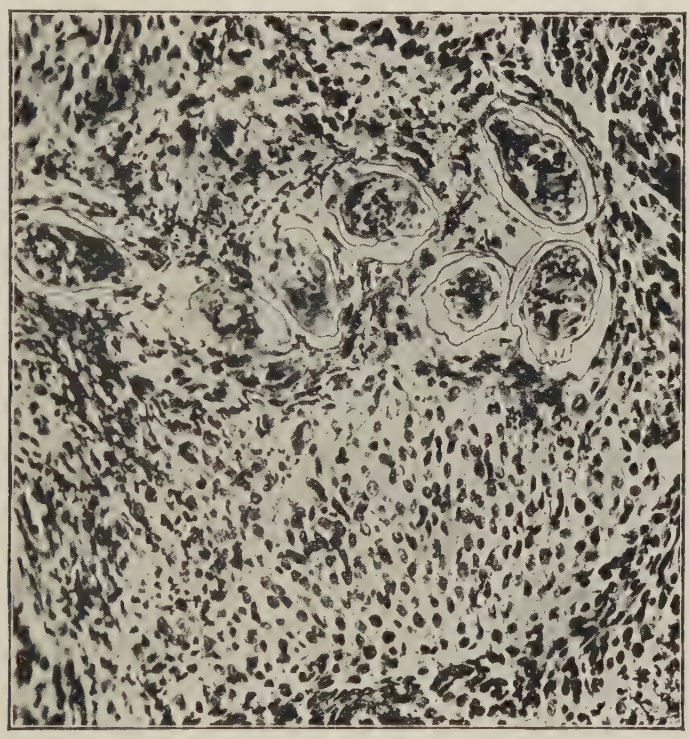

Fig. 149.—Bilharzia embryo.

at the end of urination, and the eggs of the parasite can be found with the microscope in the last portion of the urine voided. Examination with the cystoscope shows the bladder-wall dotted over with brilliant, white spots, surrounded by healthy mucous membrane, the white spots being the tails of the adult worms seen through the mucous membrane.

TREATMENT.

When the disease is established it must be left to die out of itself, although fluidextract of male fern, in 15-minim doses three times a day for a fortnight, is said to be of value, and any irritation of the bladder can be controlled by giving 3 grains of methylene blue twice a week.

If cystitis or calculus be present they must be treated on general principles.

ULCER OF THE BLADDER.

Ulcers of the bladder are not infrequently seen in cystoscopic clinics where students are being taught the use of this instrument, and are caused by an incorrect judgment of the distance between the hot lamp and the bladder-wall.

They also occur in tuberculosis, cystitis, and malignant tumor, but very rarely a solitary ulcer the size of a 10-cent piece in an otherwise healthy bladder, and without history of traumatism or injection, is met with.

The cause is unknown, but is thought to be probably due to an infective embolus of bacteria deposited in the bladder-wall.

The ulcer occurs in young persons with no venereal history, and is characterized by increased frequency of urination by night as well as by day, and hematuria, which may be profuse. The urine contains a few pus-cells, but no bacteria. After a time cystitis is established and the urine becomes purulent.

The tendency of the ulcer is to increase in size; after a time it becomes covered with phosphatic incrustations, and after persisting for a considerable length of time frequently heals and causes a certain amount of contraction of the bladder.

The diagnosis is made by finding with the cystoscope a solitary ulcer on the posterior wall of the bladder, to the inner side of the ureters, and excluding all other known causes of ulceration.

TREATMENT.

The usual treatment for a cystitis may be employed, but usually fails, although the writer cured one patient with strong instillations of nitrate of silver. After milder measures have been unsuccessfully used, it may be possible to expose the ulcer through an endoscope, and curette or paint it with silver-nitrate solution.

If this fails, Albarran advises suprapubic cystotomy, free exposure of the interior of the bladder, excision of the ulcer and an area of mucous membrane surrounding it, and suture of the incision in the mucous membrane, with closure of the bladder and drainage by tied-in catheter.

CYSTOSCOPY.

Until the year 1879 the only means of studying pathological changes in the bladder was upon the autopsy table, but the invention of the cystoscope by Nitze at this time marked an epoch in the progress of genitourinary surgery.

There are at present two forms of the cystoscope in use: one in which the observer looks directly at the object, through a tube provided with lenses or otherwise. The Brenner cystoscope and Howard Kelly's tubes are representatives of this class. *Second,* the cystoscopes with

Fig. 150.—Urological table for cystoscopy, urethroscopy, and irrigating dilatations. Used by the author and made after the German model by Tascarella Bros., 65 George St., Brooklyn.

prisms inserted in the vesical end of the shaft, through which the observer sees the object reversed in the vertical diameter, as in the Nitze-Leiter instrument.

For merely observing the alterations in the bladder, the Nitze observation cystoscope is the most useful instrument, on account of its large field of view.

For ureteral catheterization opinions are divided as to the best instrument. With the direct-view instrument of the Brenner type, as modified by F. Tilden Brown or Cabot, it is possible to catheterize the ureters with great ease, provided they can be seen.

It often happens, however, that from various causes the ureter openings cannot be brought into view, and consequently the catheter cannot be introduced.

On account of the difficulty of finding the ureters with the direct-view instrument, the double catheterizing cystoscope of the Nitze type is in general to be preferred.

With this instrument the ureters are more readily found, but it requires more experience and a certain skill in technique to catheterize them.

It is of the greatest importance that whatever form of instrument is used it should be one by which both ureters can be catheterized

Fig. 151.—Nitze's observation cystoscope.

simultaneously, for the present diagnostic methods as applied to diseases of the kidney demand a comparison between the right and left urines which are secreted at the same moment.

In cases of pyuria, especially when tuberculosis is suspected, it is usually better not to use the cystoscope at once for diagnosis, but to relieve the cystitis by washing the bladder with nitrate of silver, 1 : 1000, three times a week for a fortnight.

The urine should, during this time, be examined for crystals, pus, and tubercle bacilli.

After fourteen days of bladder-washing, when no improvement occurs, the patient may be examined with the cystoscope.

If cystitis is present, it may be primary or secondary to disease in the kidneys. Hemorrhages or cystitis bullosa around the mouth of one ureter indicates that the kidney on that side is diseased.

To determine the condition of the kidneys, catheterization of the ureters is the only means of diagnosis.

The objection which was formerly urged against this procedure, on account of the danger of infection of the kidneys, is unfounded.

After the ureters have been catheterized the patient should drink three or four quarts of water, to wash out any organisms which may

have been introduced, and urotropin, gr. vij, *t. i. d.*, should be given internally.

In most instances it is better to examine the bladder with an observation cystoscope and note the conditions, particularly the appearance of the ureters and their location, but to defer catheterizing the ureters if it should be necessary until another day.

Technique of Cystoscopy.—There are certain conditions which are necessary to the performance of cystoscopy:—

I. The urethra must be large enough to admit the cystoscope.

II. It is desirable for the bladder to hold at least five ounces; with this quantity it can be examined easily with the cystoscope. The minimum quantity of fluid which is necessary for cystoscopy is three ounces, but more fluid is necessary for catheterizing the ureters.

III. A clear medium is required, for if the fluid in the bladder is turbid from blood or pus it is impossible to see anything.

The *contraindications* may be briefly stated as any acute inflammation, and in bladder tuberculosis extreme care with regard to traumatism and infection must always be exercised.

It is always well to proceed with the examination of the bladder in a systematic manner, and the following scheme is a convenient one to adopt:—

1. Note capacity of bladder.
2. Form of sphincter of bladder.
3. Appearance of bladder.
4. Form of ureter openings.
5. If changes are present around ureter opening.
6. If pus or blood issues from the ureter.
7. Configuration of the floor of the bladder.
8. Examine posterior part of the bladder, by sinking the ocular end of the cystoscope.
9. Examine the bladder-walls by turning the cystoscope around so that the beak points upward.

Immediately before the examination, the patient divests himself of trousers and drawers and lies on his back on a suitable table, with his legs resting on stirrups in the lithotomy position.

The urethra should be thoroughly irrigated with oxycyanide-of-mercury solution, 1:4000, and the bladder is first emptied of urine with a catheter and then irrigated to remove all pus and blood.

One dram of a 4 per cent. novocaine solution is instilled into the posterior and anterior urethra with an Ultzmann syringe, or a 2 per cent. eucaine solution is injected into the anterior urethra with a P-syringe.

The bladder is then filled through a catheter with from 4 to 8 ounces of sterile water or a solution of oxycyanide of mercury, 1 : 4000.

The electric current is turned on and the cystoscopic lamp tested. The current is then shut off, the instrument lubricated with glycerin, particularly the lamp and window covering the lens, and introduced. The light is then turned on and the examination begun.

As most of the diseased processes occur in the trigone and about the ureteral openings, the beak of Nitze's cystoscope is turned downward and these parts are carefully inspected.

As the cystoscope is withdrawn toward the operator a dark zone covers the window; this is the prostate, and if the instrument is farther withdrawn the light is entirely obscured, as the cystoscope enters the urethra.

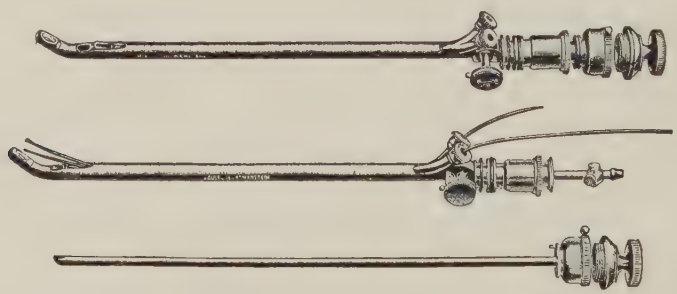

Fig. 152.—Nitze's double catheterizing cystoscope with attachment for irrigation of bladder.

After the middle and lateral lobes of the prostate have been examined, the trigone should be inspected for evidences of cystitis or for calculus.

The ureteral orifices should next be sought for. The conformation of the ureteral orifice often suggests disease of the kidney.[1] Positive evidence of disease of the kidney, however, can only be attained by **catheterization of the ureters.**

For this purpose one of the forms of catheterizing cystoscopes is employed. The ureters are brought into the field of vision and the catheters are introduced into both open ureteral mouths.

They are allowed to remain there for a few minutes, or until enough urine has been collected in a bottle for examination, and then the catheters are withdrawn.

There are many forms of catheterizing cystoscopes in use, and each one has its own special advantage; but with any instrument a very considerable amount of practice is required to find the ureters in every case.

[1] Ureteric Meatoscopy in Obscure Diseases of the Kidney, E. Hurry Fenwick, 1903.

To find the ureters with a cystoscope of the Nitze type, if the beak be pointed upward, a bubble of air will be seen floating on the surface of the water in the bladder. After finding the air bubble, which serves as a landmark, the beak of the cystoscope should be turned to the right or left so that it points downward at an angle of 45 degrees. This will usually bring one ureter into the field. If the ureter does not appear at once in the field search should be made for it by pushing the cystoscope farther into the bladder or withdrawing it along the same line, and in this way the ureter may be brought into view.

Another important landmark is the interureteral line, which is the posterior boundary of the trigone, and is formed by the pink mucous membrane of the bladder shading off into the lighter membrane of the trigone. The ureteral openings are found at its lateral terminations.

They appear as slits situated on a slight elevation and are often recognized by a swirl of urine which is seen issuing from their mouths.

After the cystoscopic examination has been completed, the bladder should be emptied and washed out with a 1 : 4000 nitrate-of-silver solution, to avoid the danger of exciting cystitis.

Cases of *acute cystitis* are difficult to examine with the cystoscope, for the injection of a sufficient quantity of water to distend the bladder causes severe tenesmus and forces it to expel its contents.

Hence the cystoscope should not be used in acute cystitis, unless some urgent indication is present.

On introducing the cystoscope into an inflamed bladder, the observer notes that the normal grayish-yellow color is changed into a red, which varies from a pale to a blood red, and may be generally diffused or limited to certain areas.

The blood-vessels show marked changes. In acute cases the vessels are seen engorged with blood, but in chronic cases the vessels are no longer to be recognized as such.

Superficial hemorrhages of irregular shape and size are to be seen in acute inflammations. In chronic cases, hemorrhages are also present, but less extensive and of a darker color.

The mucous membrane has lost its brilliance, is swollen and softened, and appears dull, spongy, and velvety.

The diseased portions are in localized areas and do not extend equally over the whole bladder.

The swelling of the mucous membrane may be so great in spots that it bulges out into the bladder and may be mistaken for a polypus. More or less of the catarrhal secretion may usually be seen, adhering to the walls or floating free in the cavity of the bladder.

In order to differentiate between acute and chronic cystitis, it is to be noted that in acute cystitis the blood-vessels are highly engorged and the changes in the mucous membrane and the hemorrhages are limited to circumscribed spots, while in the chronic form the swelling

Fig. 153.—Posterior boundary of trigone and blood-vessels. Normal bladder.[1]

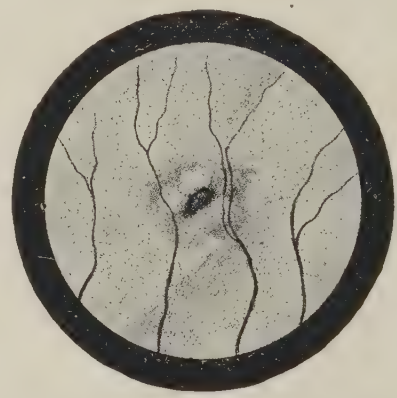

Fig. 154.—Orifice of ureter upon elevation. Normal bladder.

Fig. 155.—Ureter expanding as urine issues from it.

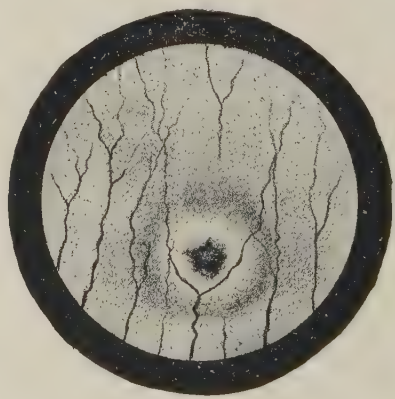

Fig. 156.—Ureter of old man dilated from calcareous degeneration.

and softening of the mucous membrane and involvement of a considerable area are prominent features.

All forms of cystitis occurring where there is an obstruction to

[1] The author is indebted to Dr. Henry G. Spooner and the Post-graduate Medical Journal for illustrations Nos. 154 to 164.

emptying the bladder, as in stricture, hypertrophy of the prostate, paralysis of the bladder, etc., are accompanied by hypertrophy of the muscular fibers of the wall, forming trabeculæ, and more or less diverticulum formation is apt to occur.

Fig. 157.—Cystitis. Blood extravasation and distended vessels.

Fig. 158.—Trabeculated bladder.

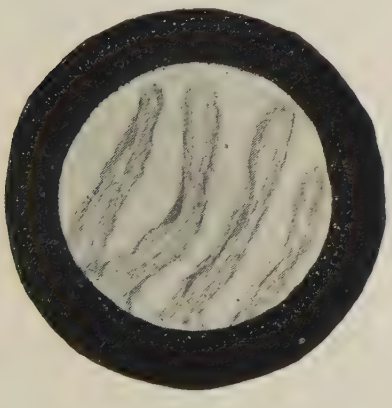

Fig. 159.—Villous papilloma of bladder.

Fig. 160.—Papilloma from neck of bladder.

Ulcerations of the bladder are, in general, significant of tuberculosis, although they occasionally occur in very severe forms of cystitis and sometimes result from an inexperienced operator burning the bladder-wall with the cystoscopic lamp.

Tuberculosis, however, may be strongly suspected when ulcerations and numerous blood extravasations are present and the intervening areas of mucous membrane are nearly or quite normal.

The location of tuberculous ulcers depends on the source of infection.

In descending tuberculosis the ulcerations are about the ureters; if the infection extends from the prostate and vesicles, the fundus is the seat, and in primary tuberculosis of the bladder the nodules begin on the posterior wall.

Tuberculous ulcerations always result from the cheesy degeneration and breaking down of tuberculous nodules, but cases seldom come under observation early enough for the nodules to be seen.

When present, however, the cystoscope shows the floor of the bladder beset with nodules, the size of a barleycorn and of a gray color, and in other parts of the bladder small ulcerations appear.

Fig. 161.—Cauliflower-shaped papilloma of bladder.

Fig. 162.—Hypertrophy of median lobe of prostate.

Of all the pictures seen with the cystoscope, bladder *tumors* are the most characteristic and well marked, as they project prominently from the surface of the bladder-wall. They may be sessile or pedunculated, and are usually located near the orifice of a ureter or the urethra.

Generally the tumors are multiple, and a complete examination should include the entire bladder.

Hemorrhage quite often interferes with the view, and one of the ordinary forms of the irrigating cystoscope may be required in order to see. Adrenalin solution injected into the bladder is sometimes of use, but the bleeding may be so excessive that examination with the cystoscope is impossible.

On account of the difficulty of introducing the instrument and the danger of a traumatism, with subsequent bladder infection, cystoscopy can frequently not be employed in cases of *hypertrophied prostate*.

In a few cases, however, where rectal palpation shows no enlargement of the gland and yet when the patient cannot empty his bladder, the cystoscope will show an enlarged middle lobe, which blocks the vesical outlet and prevents the outflow of urine.

Without the cystoscopic examination it is impossible to differentiate such cases from arteriosclerosis of the vessels of the genitourinary tract, with consequent degeneration of the detrusor muscle, which presents a similar clinical picture.

Vesical calculus is very easy to diagnose with the cystoscope, while if it is very small or lies in a pouch behind the prostate or in a bladder diverticulum it may be quite impossible to touch with a stone-searcher.

It is difficult to estimate the size of a stone accurately with the cystoscope, as it apparently increases or diminishes with the focal distance of the instrument.

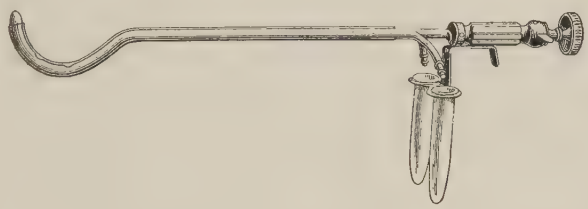

Fig. 163.—Luy's segregator closed before introduction into bladder.

The color of the stone is a guide to its constituents. Uratic calculi are pale yellow, phosphatic are white, and oxalates are brownish or nearly black. The number of stones present cannot be accurately determined with the searcher, but can be counted with the greatest ease by means of the cystoscope.

SEGREGATION OF URINES.

The difficulties attendant on ureteral catheterization led to the employment of other means to secure the separate urines from each kidney.

All of these devices act by establishing a watershed in the bladder, with a ureter on either side, so that the drops of urine coming down from each kidney will flow outside the body without being mixed.

Luy's instrument may be taken as the type. It consists of an instrument with a marked Benique curve, which after introduction into the bladder is arranged so that the rubber diaphragm, with which it is provided, is stretched, dividing the bladder into two halves with a ureter on either side.

The various urinary separators are occasionally useful, but are not free from disadvantages.

In the first place they can only be used in a healthy bladder whose mucous membrane is free from blood and pus; otherwise, the greatest errors can arise; for this reason a cystoscopic examination must always precede their use.

Their introduction is somewhat painful, and above all the reliability of the separation of the urines is not always free from doubt, for the

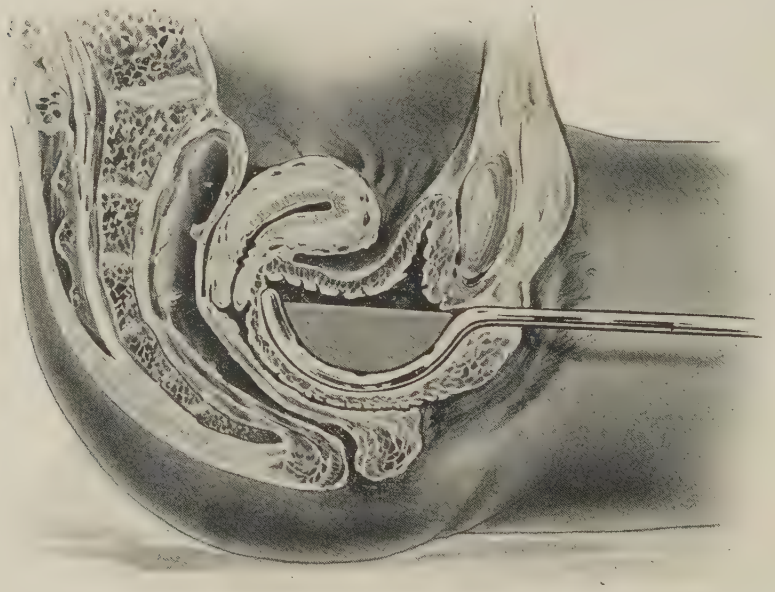

Fig. 164.—Luy's segregator opened in bladder.

rubber membrane may tear, or the instrument may not lie close against the bladder wall, leaving a communication between the two halves, through which the urine flows.

On these accounts the use of the separator may be limited to the cases where ureter catheterism is impossible, and if it is used the findings may only be considered reliable when the urine from one side is perfectly normal, while that from the other side shows the changes of disease.

In cases when a differential diagnosis between the function of the two kidneys is necessary, rather than depend upon any other instrument than the ureter catheter the **chromocystoscopy** of Voelcker and Joseph is to be preferred.

This test was based upon the original experiments of Heidenhain upon

animals with indigo-carmin and applied practically to the diagnosis of kidney functional activity by Voelcker and Joseph.[1]

The test is made by dissolving an indigo-carmin tablet[2] in 10 c.c. of water and injecting it into the buttocks.

In a normal case the urine from both kidneys is colored a strong blue simultaneously in from five to eight minutes. If blue urine appears on one side within the normal limit of time and the blue is delayed on the other side for some time afterward and then only appears faintly it is evident that secreting capacity of the kidney on the delayed side is impaired. A delay of the blue appearance on both sides does not of necessity mean disease of both kidneys, but may be due to some other cause.

One great advantage of this test besides its accuracy, for it seldom fails to show disease of one kidney when present, is its simplicity. Catheterization of the ureters is not necessary. All that is needed after injecting the blue is to watch the ureteral orifices with the cystoscope and note the time when the blue appears on each side.

Before making the test the patient must abstain from drinking any water for five hours; otherwise, the excretion of blue is delayed on both sides.

ENURESIS IN CHILDREN.

Nocturnal incontinence of urine is a very frequent source of annoyance in childhood. It may continue uninterruptedly from infancy, or may begin after the fourth or fifth year, and affects boys and girls with equal frequency.

The incontinence usually occurs only at night, as during the day the child is able to control it by the exercise of the will; but sometimes the irritability of the bladder is so marked, even by day, that unless the child responds at once to the call the urine is passed in the clothes. At night the emptying of the bladder does not take place when it is overfilled with urine, but usually occurs three or four hours after going to bed.

THE ETIOLOGY

of enuresis is very obscure, and it has been variously regarded as a paralysis or faulty development of the sphincter vesicæ, as a spasmodic contraction of the detrusor, or as a mere irritability of the posterior urethra.

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[1] Diagnose des Chirurgischen Nervenerkrankungen unter verwertung des Chromocystoskopie, 1906.

[2] The tablets of indigo-carmin, 0.08; sodium chloride, 0.1, are made by Brückner Lampe and Co., Berlin.

Casper explains the condition by assuming that there is a faulty relation between the innervation of the detrusor muscle of the bladder and its sphincter. This permits of a spasmodic contraction of the detrusor which is strong enough to overcome the muscular tone of the sphincter.

Before deciding that the trouble is purely functional, it is necessary to exclude certain local conditions, such as balanitis or phimosis, irritation in the rectum from pin-worms or obstinate constipation, vesical calculus, cystitis or tuberculosis of the bladder, foreign body in the urethra or a narrow meatus, excessive acidity of urine, and in female children an adherent clitoris.

General conditions may also play a part more or less directly in causing enuresis; epilepsy, rachitis, diabetes, polyuria, and nephritis may all be responsible for this symptom.

A want of proper bringing up may here and there be responsible for the condition, and in a few cases it is due in the first place to carelessness. The child wakes at first, but will not take the trouble to get up to empty his bladder. Later on he does not wake up thoroughly and voids the urine in the bed semiunconsciously.

TREATMENT

is generally effective, both in the cases where a cause can be discovered and removed, and also in the purely functional cases.

In children suffering with functional enuresis, the *dict* should be regulated, avoiding all indigestible and fermentative foods and not allowing any drink for an hour before going to bed. The child should be awakened once or twice at night and made to empty his bladder, and he should sleep on a hard mattress and not too warmly covered.

Belladonna is the drug upon which most reliance is to be placed.

It should be given in increasing doses until the physiological effect is obtained or until the child is cured.

The dose, on beginning, for a child 4 years old, may be 3 drops three times a day, increased 1 drop daily. When 10 or 15 drops of tincture of belladonna have failed to control the enuresis, aromatic tincture of rhus has been successfully used, increasing the dose gradually to 30 minims a day.

If this fails, Osthiemer and Levi[1] advise a solution containing $\frac{1}{240}$ grain of atropine and $\frac{1}{480}$ of strychnine to the drop. The initial dose of this is one drop a day, increased one drop daily until symptoms of the physiological action of atropine or strychnine appear or the enuresis

[1] Journal of the American Medical Association, December 17, 1904.

ceases. Under these plans of treatment 75 per cent. of recoveries may be expected.

Elevating the foot of the bed on two chairs is recommended by Stumpf, as in this way the urine in the bladder does not press down against the sphincter. The explanation of the method of action is not entirely clear, but the clinical fact is well attested.

Faradization of the bladder three or four times a week is a valuable measure. One pole is placed over the bladder region against the symphysis, and the other is carried into the rectum. The strength of the current is graduated to the patient's feeling and is often followed by success.

In cases where these measures fail, local treatment of the urethra with sounds and instillations of nitrate of silver may be tried. On account of the timidity and nervousness of children, it is very difficult to use instrumentation of any sort within their urethras, and the liability of a sudden movement causing a false passage must always be borne in mind.

DISEASES OF THE PROSTATE.

CHAPTER XIII.

SENILE HYPERTROPHY OF THE PROSTATE.

THE prostate is placed like a sphincter around the first inch of the urethra. It consists of two lateral lobes and a median central portion connecting them, which is sometimes spoken of as a third, or median lobe. In its histological structure it resembles the uterus in the female, and is composed of muscular fibers, glandular elements, and a connective-tissue stroma uniting them.

While the gland may be enlarged as a result of gonorrhea or sexual abuses in young men, *true hypertrophy* of the prostate never occurs until the decline of life, when other degenerative changes incident to advancing years begin. It is very seldom observed until the patient is *past his fiftieth year.*

Sir Henry Thompson states that hypertrophy of the prostate exists in 34 per cent. of men at and above 60 years of age, and that it produces manifest symptoms in about 15 or 16 per cent. of the cases when it is enlarged.

For many years the *cause* of prostatic hypertrophy was the subject of much speculation, although Virchow, in his work on tumors, stated that it was due to chronic inflammation which started in the glandular substance of the prostate.

This view did not attract much attention, and the general opinion was that a certain amount of enlargement of the prostate was a senile process.

In very recent times the work of Ciechanowski,[1] published in 1900, and of R. H. Greene and Harlow Brooks,[2] of New York, demonstrated positively that the enlargement is due to a chronic inflammatory process, which usually has been in progress for many years.

In frequent instances this inflammation may be of gonorrheal origin, but not necessarily so.

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[1] Mitteil. a. d. Greuz gebieten d. Medizin u. Chirurgie, vii Bd., Jahr 1900; English translation by Dr. Robert Holmes Greene; published by E. R. Pelton, 1903.

[2] Nature of Prostatic Hypertrophy, Journal of the American Medical Association, April 26, 1902.

The inflammation begins in the prostatic urethra, near the verumontanum, and when not due to gonorrhea may be very often accounted for as the result of excessive irritation from overfunctional activity or from some form of unphysiological sexuality, such as masturbation or coitus reservatus.

These acts lead to a violent engorgement of the posterior urethra, and, unless the congestion is relieved by a period of absolute rest, the tendency to a low grade of chronic inflammation soon develops, in which, no doubt, micro-organisms carried by the blood-current or urine have a contributory action.

PATHOLOGY.[1]

The pathological change consists in a general enlargement of the entire organ, or the increase in size may be confined to one or both lateral lobes or to the median lobe. The character of the enlargement of the gland and its size and consistency depend upon which of the normal tissues of the prostate have been chiefly affected by the process of hypertrophy.

Prostatic hypertrophy occurs in two distinct forms, fibrous and adenomatous. The **fibroid variety** of hypertrophy is due to a hyperplasia of the connective-tissue elements of the prostate, which lie between the tubules.

The growth and contraction of this tissue result in the compression of the gland tubules, which atrophy in consequence, so that in the pure fibrous hypertrophy the gland is transformed into a firm fibroid mass, containing a few glandular elements.

This variety is often irregular in shape, for the reason that the hyperplasia does not take place equally in all parts of the gland.

It has been asserted that the involuntary muscle fibers in the prostate participate in this form of hypertrophy, but more recent investigations apparently exclude muscular hyperplasia.

The cause of the fibroid form of prostatic hypertrophy is undoubtedly the same as that causing connective-tissue hyperplasia elsewhere, viz., *inflammation.*

Connective tissue of inflammatory origin, after the acute stages which excite its growth have passed, always contracts, as in the formation of a cicatrix.

It may thus happen that a small, hard prostate will in some cases result as a terminal stage of the fibroid form of prostatic hypertrophy, although this form of pure fibroid hypertrophy is exceedingly rare.

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[1] For the description of the pathological changes in prostatic hypertrophy, the author is indebted to a personal communication courteously made to him by his friends, Drs. R. H. Greene and Harlow Brooks.

The **adenomatous form** is characterized by the presence of round or oval tumors of a semielastic consistence, which form in the substance of the prostate gland.

In the adenomatous form the epithelial or secreting elements of the gland are involved by the hyperplasia, the result being that greater or less increase in the number and size of the tubules of the gland is

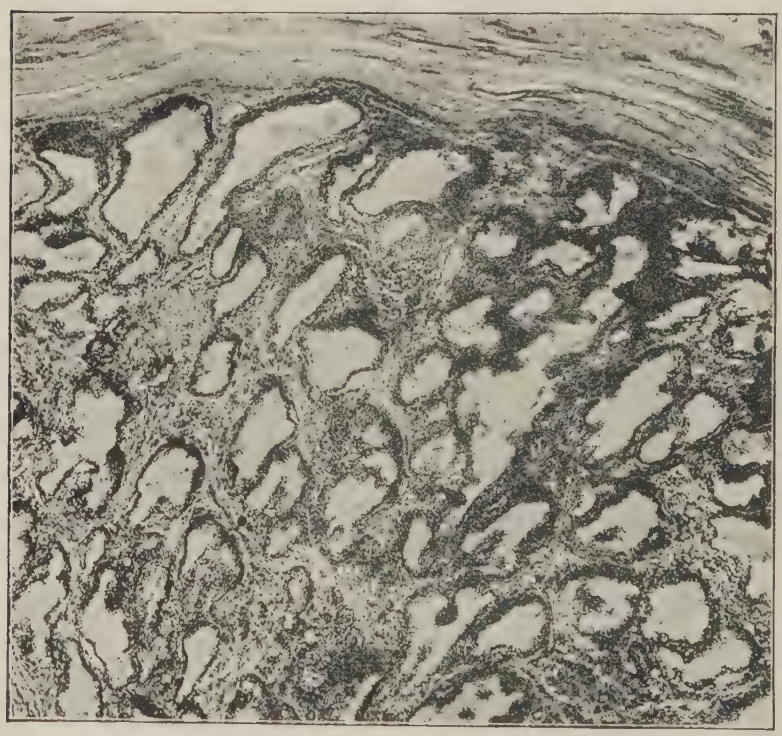

Fig. 165.—Hypertrophied prostate. Adenomatous type.

occasioned. The connective-tissue elements in the pure type of adenomatous hyperplasia are not at all or but slightly increased. In this form of prostatic hypertrophy the tubules of the gland frequently become dilated and elongated, and are filled with (*a*) the secretion of the cells, which is more or less inspissated; (*b*) by proliferating cells derived from the walls of the acini, or (*c*) by the detritus resulting from the disintegration of these cells.

The nodules formed may range in size from a pea to a hen's egg, and each may contain many or few acini.

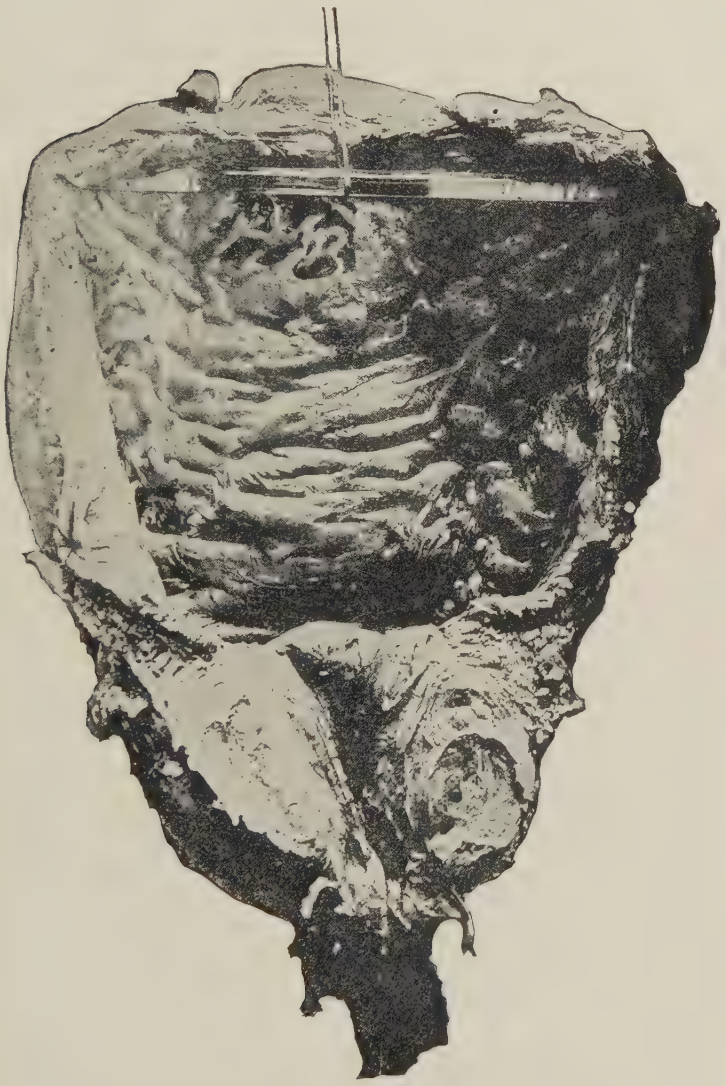

Fig. 166.—Prostatic hypertrophy. Median enlargement, in the form of a bar. Suitable for Bottini's operation. A large bladder. (By courtesy of *Dr. F. S. Watson.*)

This type of prostatic hypertrophy is induced by inflammation, as in the first-named variety; but in the adenomatous form the inflammation affects primarily the tissues surrounding the excretory ducts, and by the compression of these ducts the secretion becomes dammed up within the tubules of the gland, which thus become distended.

This is accompanied by an inflammation, which excites the epithelium of the secreting tubules to growth, and by the proliferation of these cells new acini are formed. It is thus evident that, while the structure of the tumor resembles that of ordinary adenomata, its etiology and manner of growth exclude it absolutely from the new-growth formations.

The cyst-like nodules formed in the adenomatous type of prostatic hypertrophy thus originate from the distention and growth of the normal tubules, which have become obstructed and hyperplastic, as the result of inflammation acting as above described.

The nodules may thus consist of a single occluded and distended tubule, with its wall, or of any number of hyperplastic tubules, of greater or less size, depending upon their individual distention.

The **mixed type** of prostatic hypertrophy is by far the most frequent. In it, both the tubules and connective tissue of the normal gland partake in the process, and as a result areas of fibrous formation are found, intermingled with enlarged and cystic tubules. Thus the nodules found in this variety consist both of fibroid masses and adenocystic tumors.

Carcinoma not infrequently arises, as a complication of the changes described in hypertrophied prostate, as is shown particularly by Albarran and Hallè.

The **size** to which the prostate may grow depends upon the nature of the tissue involved. The prostate may be only slightly increased in size or it may become as large as a hen's egg or an orange, and in very exceptional instances may reach the size of a cocoanut, and fill up the entire pelvis.

Form of Obstruction.—In certain cases the lateral lobes may be enlarged, but in such a way as not to interfere with the urinary outlet, and it is possible to empty the bladder entirely. As a rule, however, **the posterior median portion, or third lobe**, becomes enlarged, and assumes the shape of a bar or dam across the mouth of the bladder, behind which the urine accumulates and cannot flow out, or the outgrowth may be more circumscribed in form and act as a ball-valve, which shuts down over the vesical orifice.

Alexander has recently suggested that the enlarged prostate interferes with the rhythmical contraction of the detrusor muscle, in the region of the trigone, and the bladder, on this account, is incapable of emptying

itself of the last few ounces of urine, which are normally expelled by the action of this muscle. This view will serve to account for the cases in which there is no appreciable obstruction in the shape of a projecting growth from the prostate, but where residual urine accumulates.

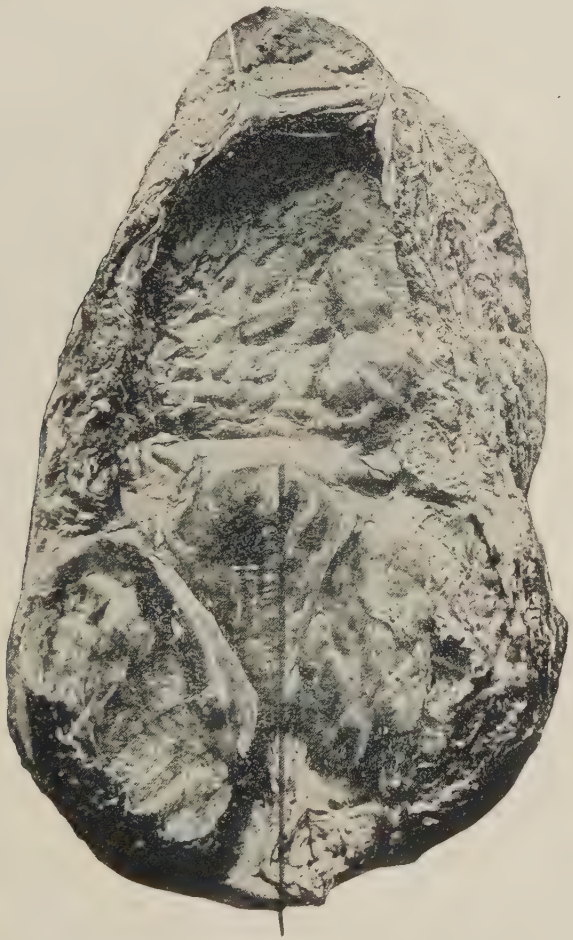

Fig. 167.—Prostatic hypertrophy. Enlargement of lateral lobes and median portion. Bladder contracted and non-distensible. (By courtesy of *Dr. F. S. Watson.*)

In many instances the enlargement of the prostate does not produce any symptoms, and it is only of consequence when it acts as an obstruction placed at the outlet of the bladder, thus preventing it from completely evacuating its contained urine.

The various symptoms and diseased conditions which occur in consequence of the prostatic hypertrophy are all due to two conditions:—

(*a*) The obstruction caused by the enlargement of the prostate at the vesical outlet interferes with the urinary outflow, and the bladder cannot be completely emptied by the muscular efforts of the patient.

Fig. 168.—Prostatic hypertrophy. Enlargement of lateral and median lobes. Deep postprostatic pouch. Case especially adapted for suprapubic prostatectomy. (By courtesy of *Dr. F. S. Watson.*)

Residual urine accumulates, pathological changes occur in the bladder-wall, and secondarily the ureters and kidneys become affected.

(*b*) The return-flow of venous blood from the bladder-wall is prevented by the pressure exerted upon the veins by the enlarged prostate, and a congestion of the bladder-walls occurs as a result.

Changes in the Urethra.—In consequence of the enlargement of the prostate, notable alterations occur in the prostatic urethra:—

(*a*) It becomes elongated.

(*b*) The normal curve is changed.

(*c*) The caliber of the urethra, instead of being round, is flattened from side to side by the pressure of the lateral lobes, so that it becomes a vertical slit.

As a result of these changes catheters of ordinary shape are often inapplicable to cases of prostatic hypertrophy, and special catheters have to be employed.

Changes in the Bladder.—The alterations which occur in the bladder are partly due to the increased muscular effort required to empty it and partly to a secondary infection and inflammation (cystitis).

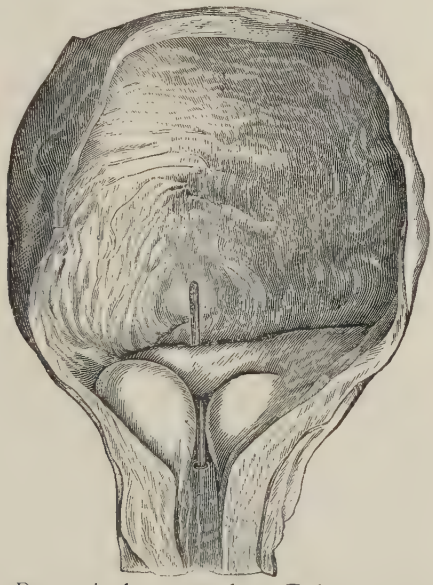

Fig. 169.—Prostatic hypertrophy. Enlargement of the lateral lobes, with increase in size of the median portion, forming a bar, through which a false passage has been made.

The bladder-wall, especially the region of the trigone, is in a state of chronic passive congestion, which is explained by the fact that the enlarged prostate presses on the plexus of veins lying around it, and so obstructs the flow of venous blood. As the blood from the bladder is returned through this plexus, any interference with its circulation causes a passive congestion of the bladder-walls. Through the day the muscular activity improves the circulation, but at night the muscles are in repose, and a passive hyperemia occurs.

The increased frequency of urination at night often helps to distinguish a case of enlarged prostate from one of vesical calculus. In the case of a stone the desire to urinate is more frequent during the

day, when the stone is rolling about in the bladder, but at night the patient is quiet in bed, and the stone does not cause much irritation.

One of the most important conditions from the standpoint of treatment and prognosis which enlarged prostate gives rise to is **residual urine.** Residual urine may be defined as the urine which remains in the bladder after the patient has voluntarily tried to evacuate it completely, and always occurs as a result of an obstruction.

After residual urine has existed for a varying length of time **cystitis** is generally excited by the entrance into the bladder of micro-organisms, coming from the urethra or rectum or introduced artificially upon a dirty catheter.

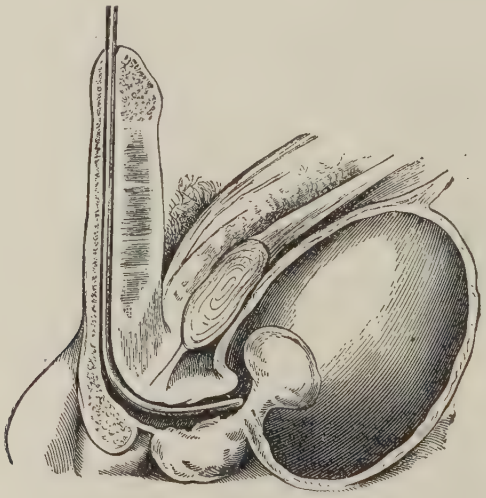

Fig. 170.—Prostatic hypertrophy. Pedunculated middle lobe obstructing passage of a catheter. Diagrammatic.

The causation of cystitis is favored by the stagnant residual urine and also by the catarrhal mucus, which is formed in the congested mucous membrane lining the bladder, as a result of its condition of chronic passive hyperemia.

The urea of the urine is decomposed by bacterial action, assisted by the presence of the catarrhal mucus, and carbonate of ammonia is set free. The urine becomes alkaline in reaction and ammoniacal in odor, is strongly irritating, and adds still further to the existing inflammation of the bladder-wall.

When cystitis is well established, the frequency of urination is increased, and the patient *urinates as frequently by day as at night.*

The mucous membrane of the bladder surrounding the urethral orifice becomes turgid and congested, and serves to occlude still more

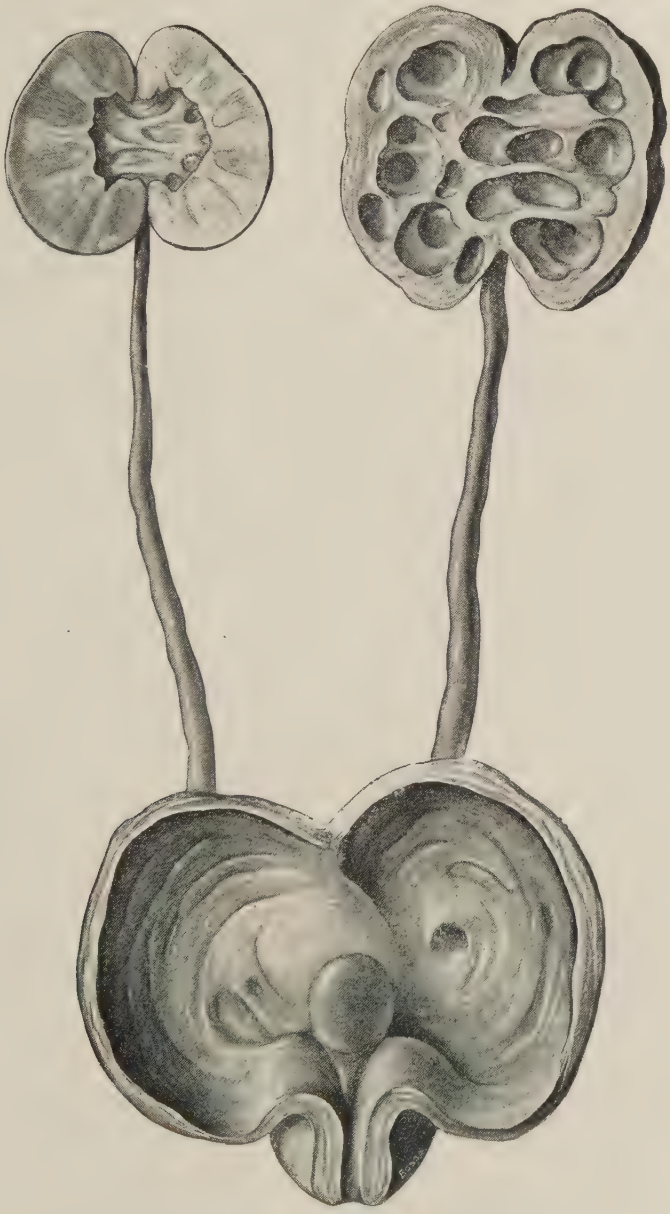

Fig. 171.—Hypertrophy of prostate. Intravesical enlargement of middle lobe, giving ball-valve effect. Dilatation of left ureter and pyonephrosis of left kidney.

the outlet from the bladder, and the residual urine increases. The various changes dependent upon cystitis and obstruction lead to **changes in the wall of the bladder.** In order to furnish sufficient propelling force to overcome the obstruction formed by the prostatic overgrowth, the muscular fibers of the bladder-wall undergo **hypertrophy.**

The bundles of muscular fibers grow larger and project into the bladder, thereby diminishing its capacity, and when viewed with the cystoscope they can be seen as trabeculæ. A trabeculated bladder is always a sign of increased muscular effort, and is found in every condition which requires increased muscular force on the part of the bladder to empty itself.

The muscular straining of the bladder forces the urine between the bundles of muscle, and in time **saccular dilatations** form, which may be as large as the bladder itself. As these sacs are only covered outside with peritoneum and the serous wall of the bladder and have no muscular fibers, they cannot empty themselves. In consequence, the urine stagnates and decomposes, and it frequently happens that a calculus forms in them.

In course of time as the case progresses the hypertrophy gives place to **atrophy and distention.** The distention of the thinned bladder-wall may be very great; so much so, that it may contain a quart of residual urine and reach as high as the umbilicus.

The distention occurs so gradually that the patient is unaware of his condition, and notices only a slight feeling of weight in the abdomen, and that his habitually frequent urination is slightly increased. As the residual urine increases, the bladder grows more distended and the intervals between the acts of urination become still shorter. After the bladder is stretched and distended to its utmost capacity a new symptom occurs; that of **incontinence of urine, or constant dribbling.**

The bladder is so full that it can hold no more, and the overtaxed sphincter yields, allowing the escape of a small quantity of urine every few minutes.

The conditions of decomposing residual urine and cystitis just described provide suitable conditions for the formation of **phosphatic calculi.** As Keyes expresses it, "Stone is the logical sequence of obstruction to urinary outflow aided by vesical catarrh."

The stagnant decomposing urine deposits salts, which become glued together by a mucopus into a solid concretion, or are deposited upon a nucleus, which may be a bit of necrotic tissue sloughed off from the bladder-wall.

A single stone, or several, may exist without causing any symptoms, and they may lie unsuspected for months in the pocket behind an enlarged middle lobe. Their surfaces are smooth, and they are prevented from rolling about in the bladder, and the weakened muscular fibers of the bladder cannot drive them forcibly out of the postprostatic pouch against the vesical orifice during the act of urination.

It sometimes happens that after hypertrophy begins the bladder-wall, instead of growing weakened and atonic and ultimately becoming dilated, undergoes **hypertrophy with contraction.** In this condition the overgrowth of the prostate does not form an obstruction to the outflow of urine, and residual urine does not accumulate, and the bladder, instead of being distended and enlarged, undergoes a *diminution in the size of its cavity,* so that it may only contain six or eight ounces of urine when fully distended.

In addition to the contraction of its size there is also a permanent congestion of the vesical neck from pressure on the veins, by the enlarged prostate. This venous engorgement occasions an extreme irritability of the bladder, with an almost constant desire to urinate.

Of the two conditions spoken of, the patient with an atonied, relaxed bladder which does not cause him trouble, even though it is incapable of emptying itself except by catheter, suffers far less inconvenience than the man who has an hypertrophied, irritable bladder, and is tormented continually with an intolerable desire to urinate.

Changes in Kidneys and Ureters.—As the obstruction offered by the prostate increases, a greater amount of muscular effort is required to empty the bladder, and as a result of the pressure the urine is forced back into the ureters, causing them to become distended, and sac-like dilatations form at various points.

The backward pressure and damming back of the urine are continued, and saccular dilatations of the pelvis of the kidneys occur, giving rise to **hydronephrosis.**

The salts of the stagnant decomposing urine are deposited, and calculi are apt to form in the various dilatations in the kidney.

The process of dilatation becomes further complicated by germ-infection, which usually ascends up the ureters, and as a result causes pyelitis or abscess of the kidney.

SYMPTOMS.

The clinical picture which an old man with hypertrophied prostate presents is a result of all the anatomical changes described and presents great diversities.

For a better understanding of the subject it is convenient to adopt the classification of Guyon and divide the course of the disease into three stages:—

First Stage, or Premonitory Period.—The first symptom noticed is a slight difficulty in starting the flow of urine and a deficiency in the force of the stream, so that, instead of being projected forcibly, the stream trickles to the ground, wetting his shoes. Frequent calls to urinate are always present and usually the first thing to call the patient's attention to his condition. In addition to the venous congestion of the prostate and trigone a reflex polyuria is usually present and the nocturnal urination is accounted for by these two elements.

If the bladder is examined at this time with the catheter, no residual urine is present and it can empty itself completely.

Second Stage, or Insufficiency of the Bladder.—Slowly, often after several years, the first stage gives place to a condition of partial retention of urine; the frequency of urination increases and the patient has the unsatisfied feeling after urination which follows only a partial evacuation.

If the catheter be introduced after urination a considerable quantity of residual urine will be found remaining in the bladder.

The second stage may last for several years if the patient conducts himself circumspectly, but the residual urine slowly increases in amount as the muscular force of the bladder fails and utimately a state of complete retention begins.

Third Stage, or Period of Incontinence.—At this time the distention of the bladder has reached an enormous degree, often palpable as a fluctuating tumor extending as high as the umbilicus and containing as much as 2 to 3 quarts of fluid.

The desire to urinate may occur every five or ten minutes with the passage of a few drops of urine, or the urine may flow involuntarily from the patient almost without his knowledge, and if asked if he can pass his water he usually answers that he passes it too freely. (See Paradoxic Ischuria.)

As the backward pressure upon the ureters and kidneys becomes greater, constitutional symptoms make their appearance, particularly in old and feeble men.

The symptoms are all referred to the digestive tract and consist in loss of appetite, flatulence, constipation, and dyspepsia. The tongue is rather characteristic of the condition, and is dry and brown, and the patient emaciates slowly, and if the temperature is taken a slight evening rise is noted.

He is drowsy all the time, and his mind has lost its former alertness.

The condition is one of toxemia, and is due to the absorption of

toxic material from the urine. If cystitis has not begun the avenue of entrance into the blood is through the pelvis of the kidney, which is distended with urine, but if the bladder-wall is congested and eroded, part of the absorption may come from this organ as well as the kidneys, and is a true urosepsis.

COMPLICATIONS OF SENILE PROSTATE.

Retention of urine occurs in nearly every case of enlarged prostate, and presents itself in two forms:—

(*a*) *Acute Retention.*—This occurs suddenly in an individual who up to that time had been able to pass water with a fair degree of freedom. It is frequently brought on by chilling or wetting the surface of the body and taking cold. The sudden congestion of the mucous membrane around the vesical orifice causes it to swell up and occlude the opening entirely, in the same way that a cold in the head will close up the nasal passages.

On the other hand, the retention may be occasioned by a spasmodic contraction of the cut-off muscle (spasmodic stricture), which occurs as a reflex from constipation and scybalæ in the rectum, or an acid condition of the urine from overindulgence in wine or malt liquors.

After the retention has been relieved and the patient catheterized for some days, the ability to urinate is generally partially restored, but it is rather unusual for such a case to be able to dispense entirely with the catheter subsequently, and he enters upon the second stage of his disability.

(*b*) *Chronic retention,* as already described, is caused by the obstruction at the vesical outlet from the enlarged prostate and partly induced by the atonic condition of the muscular walls of the bladder.

Cystitis is the most common complication, and few prostatics are able to avoid it, for the condition of residual urine and passive congestion are favorable for its development.

It often results from instrumentation, or it may develop from the entrance of colon bacilli from the rectum, often appearing as an acute cystitis which becomes chronic. Under appropriate treatment a chronic cystitis improves considerably, but it is rare for it to clear up entirely.

Vesical calculi are very liable to form in the presence of cystitis, especially in untreated cases.

Pyelitis and *pyelonephritis,* with their influence upon the general condition and their effect in causing urosepsis, have already been described.

Hematuria is often observed and comes from the varicose veins underneath the mucous membrane, which develop as a result of the pressure

of the enlarged prostate upon the venous plexus of the bladder. Usually it is not alarming, but exceptionally may be so severe as to fill the bladder with clots, which, if they cannot be washed out through a litholapaxy evacuator, may require a suprapubic cystotomy to evacuate the clots and control the hemorrhage.

Epididymitis occurs very often as a result of the frequent use of the catheter. The inflamed testicle rarely suppurates, but becomes indurated and is liable to exacerbations of the inflammation.

DIAGNOSIS.

In the case of a man over 50 years of age, complaining of difficulties of urination, enlarged prostate should always be suspected.

It is desirable to conduct the examination systematically, and to that end

I. A rectal examination should be made, to feel the prostate and judge of its size and consistency and to determine, if possible, whether the enlargement is fibrous or glandular in character.

Of course, only the posterior portion of the gland can be felt through the rectum, and it is impossible to determine the shape of the obstructing overgrowth in this way, but its density and the extent of the enlargement of the entire gland can be determined by the rectal touch.

II. The quantity of residual urine should be collected and measured after the following method: The patient is requested to pass water, and endeavors to empty the bladder completely. A catheter is then introduced into the bladder, and all the urine which remains behind and which the patient has been unable to void spontaneously is known under the term "residual urine." The residual urine should be measured and set aside for microscopic examination.

The *quantity* of residual urine indicates the extent to which the prostatic enlargement interferes with the complete emptying of the bladder; but in order to determine the *shape* of the outgrowth which projects up into the bladder and blocks its outlet, we must have recourse to the cystoscope.

At the time of collecting the residual urine we can also determine the *length of the urethra* by measuring the distance from the eye of the catheter to the point upon its shaft to which it is necessary to introduce it before the urine begins to flow. This measurement often fails to demonstrate an existing enlargement, as a decided amount of obstruction may be present which causes but very little elongation of the urethra.

III. By means of a **cystoscopic examination** it is possible to see the enlargement of the middle lobe projecting upward, and to some extent to see a lateral lobe, if it impinges upon the vesical outlet. As

the cystoscope is introduced through the urethra it will also serve to exclude the presence of a *tight stricture,* and by its use in the bladder we can prove the presence or absence of *vesical calculus,* which is so apt to be present in cases of enlarged prostate with residual urine.

There are certain **precautions to observe** in every examination of prostatic cases: The patients are old men whose vitality is low and who are more or less feeble. Their urinary passages are in an irritable condition, and they are very liable to *urinary fever,* and any prolonged or rough examination is apt to be followed by chills, fever, and constitutional disturbances. For these reasons the instruments should be aseptic, and when practicable it is desirable to cleanse the urethra and bladder by irrigation before instrumentation.

The instruments should be used with extreme gentleness to avoid any traumatism, which would allow entrance of micro-organisms into the circulation, and the first examination should not be too prolonged.

It is desirable that the patient should be examined for the first time in his own home, so that he can go to bed at once after the examination, and thus avoid the necessity of going out-of-doors, running the risk of chilling the body.

The irrigation urethroscope of Wossidlo gives a good view of the posterior urethra and discloses any tumors or prominences which project into it.

A distended bladder should never be emptied at one sitting, and many an old man has met his death at the hands of a well-meaning practitioner armed with that deadly, but silent weapon of offense, the catheter.

Drawing off the entire contents of the bladder allows the enlarged blood-vessels which have been accustomed to the support of a certain amount of fluid to collapse, and a transudation of blood follows. The bladder has always been previously infected with organisms; cystitis is aggravated; toxic absorption from the bladder takes place, and marked urosepsis occurs. If the kidneys are already damaged, the secretion of urine becomes scanty and ultimately suppressed, and within a week after the first introduction of the catheter the patient is dead of septic anuria.

In the case of a man with sound kidneys, and not too feeble, he may escape with a severe cystitis.

If the bladder has been considerably distended for a long time and contains one or two quarts of urine, only a part of it should be withdrawn at one time, or if by accident all the urine has escaped through the catheter 8 or 10 ounces of boric acid or normal salt solution should be injected and left in the bladder.

GENERAL TREATMENT.

In all cases of prostatic hypertrophy **hygienic measures** are very important in preventing attacks of retention of urine. The patient should wear flannel underclothing in winter, and, as the circulation of blood is poor in the feet and these parts are most easily chilled, woolen stockings should be worn.

He should avoid any overindulgence in alcohol or malt liquors, although a glass or two of claret or a little whisky may be permitted.

The bowels ought to receive due attention, and constipation should be guarded against. Any overdistention of the bladder with retained urine has the effect of still further weakening the atonic muscular walls, and on this account the patient should be instructed to pass his water at regular intervals, two to four hours apart.

In the early stages of prostatic hypertrophy, when the enlargement is only moderate in size and not very dense, and when the quantity of residual urine is small, the chief source of annoyance to the patient is from the irritability of the bladder, which causes a frequent desire to urinate.

Such cases are often benefited by the passage of a **large-sized steel sound,** which relieves the irritability of the bladder and overcomes the muscular spasm of the urethra. The action of the sound is to press out and empty the engorged venous plexus around the prostate, and, while it does not prevent the increase in size of the gland, it seems at least to retard its growth. The sound should be used once in every five days, and allowed to remain lying in the urethra from ten to fifteen minutes at a time. The sound also lessens vesical irritability, causes the quantity of residual urine to become less, and modifies favorably the whole course of the case.

The treatment with sounds is only applicable to patients who have a slightly enlarged prostate of moderate density, which does not obstruct a catheter and where but little residual urine is present. The prominent symptom of which these individuals complain is the necessity for getting up once or twice at night to urinate.

R. H. Greene advises dilatations of the posterior urethra by means of Kollmann's four-bladed dilator in the early stages of prostatic hypertrophy, with the object of breaking up the submucous infiltration caused by the prolonged urethritis. In this way the mouths of the prostate ducts are freed and the glandular secretion is afforded a means of exit.

The presence of **residual urine** offers an important indication for treatment.

If the residual urine is only one or two ounces in quantity and clear in color, it is only necessary to pass the catheter once in four to eight

weeks, in order to observe the progress of the case and ascertain that the obstruction is not becoming greater or the atony of the bladder-wall increasing.

In time, however, the residual urine increases in amount, and when it reaches three or four ounces in quantity the catheter should be employed once a day to remove it from the bladder, a convenient working rule (if the urine is sterile) being to use the catheter once daily, preferably at bedtime, for 3 ounces, twice daily for 6 ounces, and then once more for every additional 2 ounces. With sterile urine it is rarely necessary to catheterize oftener than once in four hours.

Unfortunately, however, the bladder rarely escapes infection for any length of time after beginning catheterization, and then a new element is introduced into the case: that of **cystitis.** Inflammation of the bladder is generally ushered in by some rise in temperature, which may run for a few days and subside, or may continue for some length of time as a result of absorption of septic material into the blood.

The frequency of the desire to urinate is notably increased, and the urine contains pus, and in the early stages blood may be present.

The fermentative changes in the urine rapidly cause its decomposition, and it becomes strongly alkaline in reaction and ammoniacal in order.

After cystitis has lasted for a short time the contractility of the muscular fibers of the bladder-walls is still more impaired, and the residual urine increases in quantity, so that the catheter has to be used more frequently, in order to prevent the accumulation of urine, which is stagnant and soon decomposes.

The indications for the treatment of this condition may be summed up as follows:—

(*a*) Drain the bladder of residual urine.

(*b*) Keep it as clean and aseptic as possible, and check decomposition of the urine by means of bladder-washing and the administration of urinary antiseptics by the mouth.

For the treatment of the cystitis the reader is referred to the chapter on the treatment of chronic cystitis.

The ordinary routine treatment of a case of prostatic hypertrophy, consisting in **bladder-washing and daily catheterization,** can be readily carried out by the patient himself, if he is moderately intelligent, after he has been instructed by his attending physician.

The best form of catheter for him to use is the soft-rubber instrument, and, indeed, every patient with enlarged prostate should be familiar with the method of passing the catheter and should keep one at hand, as he is always liable to an attack of retention of urine from some

slight cause, and unless prompt relief can be obtained the bladder-wall may suffer irreparable damage from the distention and stretching caused by the accumulation of urine.

An important part of the instruction of the patient consists in teaching him the proper method for the **care of the catheter.** This is a very material point in the management of the case, and, if cystitis is not already established, the frequent use of the catheter generally induces it, unless the greatest care to avoid infection is taken by means of scrupulous cleanliness.

It is not difficult to cleanse the outside of the catheter, but the interior is its most dangerous part, on account of the difficulty of disinfecting it. (See chapter on care of urethral instruments.)

In every case the catheter should be frequently inspected, and discarded at once when it becomes dry and cracked.

At the time the patient is instructed as to taking care of his catheter he should also be taught to wash the glans penis with a cotton sponge and soap and water, every time before the catheter is introduced, in order to avoid carrying micro-organisms into the urethra from the head of the penis.

But in spite of all precautions, it is most exceptional for the urine to remain clear, and, as a rule, a slight degree of cystitis is continually present. On this account and to lessen the tendency to the formation of calculus, it is very desirable that the patient should use **irrigation of the bladder** once or twice each day.

This can be very readily done, at the time he uses the catheter, by means of a rubber douche-bag or fountain-syringe raised up three feet high and attached by its tube to the end of the catheter. The mild solutions, either boric acid, salt solution, or permanganate of potassium, or oxycyanide of mercury are suitable for this purpose.

Commencement of Catheter-life.—In cases of prostatic hypertrophy where there is little or no cystitis and the quantity of residual urine is only from 4 to 6 ounces, if due precautions are taken to guard against cystitis, the patient very soon becomes accustomed to the use of the catheter. But, in those instances where the residual urine amounts to 10 ounces or more, a considerable amount of *constitutional disturbance* usually follows the first catheterization. Urinary fever generally occurs, and, if the kidneys were previously diseased and the patient is very old and feeble, it is by no means rare for the case to terminate by death.

It is desirable, then, before beginning catheterization, in the presence of *large quantities* of *residual urine,* to warn the patient that there is some risk attached to the procedure, and to insist that he shall remain

quietly at his home and for the most part in bed for a fortnight. During that time the urine should be drawn by the catheter, three or four times a day, not emptying the bladder completely, but always leaving several ounces of urine in the bladder to distend it.

It requires about a week to empty a bladder completely. At the end of that time, if the quantity of residual urine has been reduced each day, it will usually be found that the bladder can be emptied entirely at each catheterization.

Urinary antiseptics should be given by the mouth, but it is better to avoid washing out the bladder for the first week or so, until a certain degree of tolerance is established. Under these precautions the advanced cases of prostatic hypertrophy with an excess of residual urine are introduced into catheter-life with a minimum degree of risk. But even in spite of all care patients who are old and feeble, and are suffering from chronic Bright's disease or pyelitis, sometimes develop a chronic

Fig. 172.—Mercier catheter coudé.

form of urinary fever, induced by the beginning of catheter-life, which terminates fatally.

In these instances death would have resulted from the kidney disease in any case, after a short time, and had the use of the catheter been commenced at an earlier period in the disease the secondary involvement of the kidneys would have been avoided.

Acute Retention of Urine.—Most old men with enlarged prostates suffer at some time in their lives with an attack of acute retention of urine, from spasm of the cut-off muscle and swelling of the mucous membrane at the vesical outlet. Such a condition calls for *prompt catheterization.* The use of prolonged hot baths and a full dose of opium, which so often relieves a spasmodic stricture in a young man, is not to be recommended in retention of urine from an enlarged prostate. The overdistention of the bladder must be relieved at once, as the stretching of its muscular fibers induces a condition of atony.

The form of *catheter* to be selected depends upon the shape which the overgrown prostate has assumed. It is often found impossible to introduce a flexible soft-rubber catheter, and it is necessary to try various shapes, until one is found which will override the obstruction offered by an enlarged middle lobe, or an adenomatous tumor which deflects the urethra to one side.

The form of catheter which is most frequently serviceable is the *Mercier catheter,* with the end turned up (coudé). The angled end usually slips up past an enlarged middle lobe and enters the bladder. The catheter bicoudé acts in a similar manner and is useful when the overgrowth of the middle lobe is excessive.

The *silver prostatic catheter,* with a long beak and an exaggerated curve, is especially designed to fit the elongated sweep of the urethra distorted by the prostatic overgrowth, and is frequently successful in reaching the bladder. When it fails to enter the bladder the following manipulation is often successful: The surgeon has provided himself beforehand with a common English catheter with a stylet, which has been previously prepared by giving it an exaggerated curve, and it is then laid away until needed. When it is wanted, the stylet is withdrawn and the catheter is introduced into the urethra. The warmth of the body causes the curve to increase, and the point of the instrument overrides the obstruction. The catheter may also be introduced with the stylet in it down to the prostatic urethra. When it reaches this point the stylet is withdrawn and the point of the instrument curves around the enlarged prostate.

In the manipulations with the silver and English catheters due care should be used not to make a *false passage* in the swollen tissues around the prostate. The attempts to reach the bladder with a filiform guide and a tunneled sound threaded over it are of very little use except in cases of stricture.

A bladder which is full and distended, if it has been so for more than a few hours, should *never be completely emptied at one sitting,* but 6 or 8 ounces of urine should be left in it, to support the blood-vessels and give the muscles something to contract on.

If all attempts to enter the bladder are unavailing, in order to relieve the retention it is necessary to have recourse to **suprapubic aspiration of the bladder.**

The needle attached to the aspirator is thrust directly downward, a finger's breadth above the pubes, and penetrates the bladder without wounding the peritoneum, as when the bladder is distended the fold of peritoneum covering it is raised up two and one-half inches above the pubes.

Aspiration affords prompt relief; but, while the bladder has been emptied for the space of a week by means of repeated aspirations, it cannot be done with safety more than a few times.

Suppuration often results after three or four tappings, or the bladder-wall becomes soft and leaks; so that aspiration can only be depended on as a temporary expedient, for a day or two.

In certain cases of enlarged prostate which are suffering from chronic retention, it is desirable to keep the bladder empty and at the same time avoid the frequent introduction of a catheter; to attain this end **continuous catheterization** is accomplished by introducing a soft-rubber catheter into the bladder and tying it, so that it cannot be forced out.

The indications for the use of continuous catheterization are summarized by J. W. White as follows:—

(*a*) When great difficulty is experienced in introducing the catheter.

(*b*) When much bleeding follows the introduction of the catheter, as is generally the case when unsuccessful attempts at catheterization have been made before.

(*c*) When much cystitis with purulent or ammoniacal urine exists

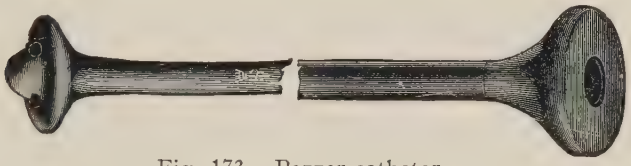

Fig. 173.—Pezzer catheter.

and the frequent passage of a catheter is impracticable on account of the pain and hemorrhage which it produces.

(*d*) As a preliminary to any form of prostatectomy when much residual urine is present in the bladder.

By means of continuous catheterization, the bladder is drained and readily washed out, and a general improvement in the symptoms takes place.

A metal catheter should, of course, never be left in the bladder, for a sudden motion of the patient may force the end through the bladder-wall. Such a wound is followed by leakage of urine, peritonitis, and death.

An ordinary woven silk or Mercier catheter may be tied in the bladder, or the Pezzer catheter may be employed with advantage, as it is not easily withdrawn, except intentionally, and the spreading end holds it in place without the necessity of tying it fast.

In order to introduce the catheter, a stylet is passed through its lumen, straightening out the mushroom-shaped dilatation at the end. When the catheter is in the bladder the stylet is withdrawn, and the mushroom expansion reappears, and by its projection holds the catheter in place.

CHAPTER XIV.

OPERATIVE TREATMENT OF HYPERTROPHIED PROSTATE.

Until within a very recent time the operative treatment of hypertrophied prostate was in the experimental stage, as may be seen by the accompanying table of operations in vogue.

A list of the operations may be tabulated as follows:—

Radical Operations.—

Bottini's Operation.

Prostatotomy { Perineal. / Suprapubic.

Prostatectomy { Suprapubic, / Perineal, or / Combination of both.

Vasectomy.

Castration, or Orchidectomy.

Palliative operations, in which no part of the prostate is removed, are only undertaken for the purpose of draining the bladder through a fistulous opening:—

(*a*) Perineal cystotomy and drainage through a catheter retained in the bladder.

(*b*) Suprapubic cystotomy.

(*c*) Puncture through the substance of the prostate with a trocar.

HISTORY OF OPERATIONS ON THE PROSTATE.

In order to understand clearly the present status of the surgery of the prostate, it is necessary to go back and study its gradual growth.

The operation of **prostatectomy** was not evolved in a night, but was a thing of slow development, each observer adding something to the sum of our knowledge.

The earliest attempt at operative interference with the prostate was a simple incision, or *prostatotomy,* through the perineum, in which a middle lobe was divided in halves, or a V-shaped piece was cut from the prostate in order to get a low-level channel from the bladder.

It was found that when the prostate was not more than three inches thick it was possible to reach a projecting median lobe through an incision in the perineum.

Once within reach, the lobe could be readily divided with a knife, or if it was nipple-shaped it could be nipped off with scissors or an ecraseur.

It was, however, found to be rarely possible by means of a simple prostatotomy to remove enough of the overgrowth of prostatic tissue to relieve the symptoms of obstruction, and the chief advantage which followed was from the benefit the patient derived from the prolonged drainage of the bladder through a catheter and the consequent improvement of the cystitis.

In 1888 a great impetus was given to prostatic surgery by two operations of McGill, of Leeds, England, who removed, through a suprapubic incision, portions of the prostate. These growths were chiefly intravesical projections, and were removed by cutting with scissors and tearing off with forceps. The suprapubic wound was subsequently utilized for bladder drainage.

In 1890, Belfield, of Chicago, advanced the technique of prostatectomy by operating through a *combination of suprapubic and perineal* incisions. In this way easier access was afforded to the prostate, and he removed the growths by enucleation, instead of cutting and tearing them off. In these operations the prostate was enucleated through the suprapubic wound, and the perineal wound was utilized for drainage.

The hemorrhage was always considerable, and often alarming, and the bleeding could only be controlled by packing not only the cavity in the prostatic capsule, but the bladder as well.

The mortality of suprapubic prostatectomy remained at a very high rate, in the cases reported reaching 20 per cent.; but if all the deaths were known the death rate would probably be much higher.

In 1895, Eugene Fuller, of New York, published an account of an improved technique for suprapubic prostatectomy with a report of 6 cases operated upon, and, in 1900, Freyer, of London, described practically the same operation, but took to himself all credit for originating it, although the details of Fuller's operative method had been described to him previously by Dr. Ramon Guiteras, of New York.

The *perineal operations* have, in the same way, been worked out by different surgeons step by step.

The first surgeon to describe the technique of enucleation of the prostate by the finger through a perineal incision was J. W. S. Gouley, of New York, in 1873, but to Bryson,[1] of St. Louis, in 1898, and Alexander, of New York, should be given the credit of applying the technique of the perineal operation for the relief of a large number of prostates, with a low rate of mortality.

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[1] Annals of Surgery, November, 1902, and St. Louis Medical Review, February 22, 1902.

The dissecting operation by which the prostate is exposed by a transverse incision and enucleated under the guidance of the eye developed on the continent of Europe, more particularly at the hands of Albarran (first publication in 1901), and were further greatly facilitated by the application of a tractor for drawing the prostate down into the wound by Hugh Young, of Baltimore, in 1903.

The former high rate of mortality in prostatectomy led surgeons to seek for other means of removing the obstructing prostate.

In 1893, J. William White, of Philadelphia, first published the results of his experiments, showing that the removal of both testicles in animals caused an atrophy and shrinking of the prostate, and in the same year Ramm, of Christiania, reported similar results.

Velpeau and Sir Henry Thompson called attention, years ago, to the similarity between the fibromyomata occurring in the prostate and those of the uterus. Following up this suggestion, White castrated a number of dogs, and found that the operation was in every case followed by a rapid atrophy, first of the glandular structures of the prostate and then of the muscular elements.

Since then it has been frequently demonstrated that, while **double castration** causes an atrophy of the prostate in animals, it does not cause a reduction in the size of the tumors which occur in hypertrophied prostate in men. It does, however, occasion a decrease in the congestion of the gland, and in this way the urinary obstruction was temporarily relieved in some cases. For a time the operation had a good deal of popularity, but today it is no longer in use and has been abandoned.

At the time castration was practised, the disinclination of patients to allow the removal of their testicles led surgeons to attempt to cause an atrophy of the prostate by means of **vasectomy**, or ligating the spermatic cord through an incision in the scrotum.

Experiments on animals show that, when the spermatic cord is divided, the prostate sometimes grows smaller. The decrease in size is accounted for by a lessening of the congested condition of the gland which takes place immediately after the operation.

Albarran and Motz, from their studies of the subject of vasectomy, conclude that resection of the vasa deferentia is often followed by a lessening of the congestion of the prostate, which causes its volume to diminish temporarily, and evokes an improvement of the dysuria, the cystitis or the retention from which the patient suffers.

There is nothing to prove that the operation causes an atrophy of the hypertrophied prostate, or that in cases of chronic incomplete retention the residual urine is diminished, if the operation is made at a time

when the prostate is not congested. There are also no records to show that after the operation the bladder is able to empty itself.

Casper believes vasectomy may be useful in two classes of cases:—

(*a*) In old men who are dependent on the catheter and who are subject to repeated attacks of epididymitis.

(*b*) In patients with slightly contracted bladders and no residual urine, but who suffer from an uncontrollable, constant, and severe tenesmus.

Casper accounts for its beneficial effects in these cases not by reducing the size of the prostate, but by severing the nerves of the vas deferens, which are in an irritable condition.

Except in such cases as just mentioned, vasectomy has been abandoned, and the only operations in use today for the radical cure of hypertrophied prostate consist in prostatectomy and very exceptionally Bottini's operation.

PRELIMINARY TREATMENT BEFORE OPERATION.

One great factor in the reduction of the operative mortality of prostatectomy is a suitable preliminary treatment instituted to ward off the most frequent cause of death afterward, viz., *suppression of urine.*

This arises from an acute congestion of the kidneys, often superimposed upon an old kidney lesion, and results from the too sudden emptying of the bladder and relief of the back pressure.

To avoid this it is necessary to withdraw the urine gradually from the bladder, requiring perhaps a week in a case of great distention for the bladder to be completely emptied. It is found that a sudden withdrawal of the intravesical pressure will throw the kidneys into a condition of acute congestion, and if they are partially disabled the sudden change may result in acute nephritis and suppression.

After the bladder has been emptied it is usually necessary to leave the catheter tied in to keep it drained and empty and use bladder washing with nitrate-of-silver solution twice daily for several days longer.

The first effect of the catheterism is often to cause a more or less severe attack of urinary fever, but as this subsides the patient's general condition and nutrition improve, and when he comes to the operating table his chances for dying of septic anuria after the operation are very slight.

In addition to the permanent catheter, 2 to 3 quarts of water should be ingested daily and urotropin given.

Castor oil is preferable to give as a cathartic before the operation rather than calomel, as it is not so depleting to the blood-vessels.

The condition of the urine is a great clinical aid in selecting the cases for operation, for if the kidneys are not capable of supporting life it is better not to attempt any radical procedure.

At the beginning of the period of drainage the urine is found to be very much increased in quantity and of a low specific gravity, 1010; generally alkaline, and with a considerable quantity of pus. As the drainage is continued, the quantity is diminished and the specific gravity increases, showing a better functional activity on the part of the kidneys.

A new method of testing the functional activity of the kidneys has been devised by Geraghty and Rowntree,[1] and consists in noting the change in the color of the urine after the subcutaneous injection of **phenolsulphonphthalein** (prepared by Hynson, Westcott & Co., of Baltimore). The test is made by emptying the patient's bladder completely and 1 c.c. of the standard solution of the drug injected into the muscles of the back.

At the end of one hour the entire contents of the bladder should be carefully collected, and the amount of the drug secreted accurately estimated by a colorimeter. Again, at the end of the second hour, another such collection and similar examination should be made.

As to the value of the phenolsulphonphthalein test the author quotes at length from Dr. Geraghty's article:—

"The phthalein test has given valuable information in all these cases and has enabled us to differentiate those cases with severe renal damage from those in which the renal involvement is slight. As a rule the test has demonstrated the greatest impairment of function in those cases which have large residual urine and have not been leading a catheter life. Clinically, this type of case is recognized as the most dangerous when operation is undertaken without preliminary treatment. In many instances in which the output of the drug was low when the patient was first seen, the adequate *régime* described above has resulted in a decided improvement of the kidney function as indicated by the test.

"When the time of appearance is delayed beyond twenty-five minutes and the output of the drug is below 20 per cent. for the first hour, operation is postponed regardless of the patient's clinical condition. If under routine treatment the output remains low but constant, the renal function is probably in a stable condition, and the operation may be undertaken, care being taken to select an anesthetic which will not further depress the renal function. In one instance a successful operation was performed with an output of 8 per cent. for the first hour, but this output had remained constant for a period of five weeks. The low out-

[1] Journal of Pharmacology and Experimental Therapeutics, July, 1910.

put here was ascribed to chronic interstitial changes in the kidney, and nitrous oxide was accordingly employed.

"When the residual urine is large and the patient has not been leading a catheter life, even if the output at a single determination is large, operation is deferred in order to determine whether the functional activity is stable, for it has long been recognized that following the relief of retention the function of the kidney is extremely variable. Repeated determinations should be made, and, except when unavoidable, operations should not be performed when the tests indicate a decreasing function. There have been two such cases in our series, in both of which operation was followed by death from acute suppression. Again when only a trace of dye is excreted, operation should not be attempted, as grave renal changes exist. Two cases excreting only a trace died of uremia within a short period. In neither case was any operation performed, though clinically at the time of the first test no evidence of uremia was detected."

CAUSES OF DEATH AFTER OPERATION.

Suppression of urine is the cause of the greater number of deaths after any form of prostatectomy, but since the adoption of preliminary drainage before, and the Murphy drip after, operation a great reduction in the mortality from this cause is noted.

Shock following the operation ought seldom, if ever, to be met with if a rapid operation with a minimum quantity of the anesthetic is used.

Hemorrhage should be watched for and the nurse ought to be constantly on the alert for this complication, which if discovered in time can always be controlled. In the case of suprapubic prostatectomy, it may be necessary to tampon the entire bladder with gauze for forty-eight hours, and in perineal cases removal of the tube, clearing the clots out of the bladder, reinserting the tube, and repacking the wound around it will always control the bleeding.

Pulmonary embolism is not uncommon, and is probably due to the dislodgment of a septic clot from the pelvic plexus of veins which is carried to the lungs.

Gangrene of the suprapubic wound and general sepsis after the high operation occasionally occur, and are due to the constant contact of the foul urine with the extensive abdominal wound after the drainage-tube is removed.

Another cause of death to which a name can hardly be assigned is rather common in very old and debilitated subjects, and seems to be due to a general and gradual failure of all the vital powers. The kidney secretion remains free and there is no rise of temperature, but the patient

loses his ability to take food, his strength fails, the wound remains sluggish without a tendency to heal, and the patient simply fades out of life, for no apparent reason except that he has reached the limit of his days and vitality.

LATE COMPLICATIONS.

Incontinence of urine rarely follows the suprapubic operation, but is by no means uncommon after the median perineal enucleation is due to damage sustained by the cut-off muscle during the operation. It usually disappears after a few months as the muscle regains its tone.

Stricture of the divided prostatic urethra may occur unless sounds are regularly passed.

Cystitis generally persists for a time after the operation, but, as the bladder can be completely emptied, it is always amenable to treatment by bladder-washing.

A suprapubic fistula may persist after the high operation, but generally closes if the granulations are curetted out, tincture of iodine applied to the fistulous tract, and the abdomen tightly strapped. A large-sized steel sound should be passed through the urethra once a week. In the event of these means failing, the patient should wear a permanent catheter for a week or two, and keeping the bladder empty in this way will always cause the fistula to close.

CHOICE OF TIME FOR OPERATING.

The improved technique and reduced mortality following radical operations for the removal of the prostate have placed the genitourinary surgeon in a very different attitude with regard to advising his patients at the present time from the position which was taken only a few years ago.

When a patient presents himself for treatment in the beginning of the second stage of hypertrophied prostate with only 4 to 6 ounces of residual urine, the bladder free from cystitis, and the kidneys unimpaired, the question arises, Shall we advise immediate operation or allow the patient to catheterize himself once or twice daily as long as he can maintain himself in comfort with the artificial evacuation of the bladder?

Two positions can be justly taken in answer to this question. In the great majority of cases the catheter affords only a temporary relief for a few months or years; cystitis and back pressure on the kidneys with increasing irritability of the urethra soon intervene, and when prostatectomy becomes unavoidable he is no longer the good operative risk that he presented at the commencement of his catheter-life.

In the majority of cases after the catheter has been used for a long time, the prostatic hypertrophy increases in size, the contractile power of

the bladder lessens, the cystitis grows worse, and the presence of a small quantity of urine in the bladder causes extreme tenesmus until it is removed. As a result of the frequent demands for urination, the catheter has to be passed so often that the urethra becomes irritable and bleeds freely, and the cystitis grows progressively worse. In the expressive words of J. W. White, the condition of the patient is that of "approaching breakdown in catheter-life." These are all indications that catheterization must be discontinued and some other means of draining the bladder adopted.

Indeed, all of the surgical operations for prostatic hypertrophy are directed to the one end of *draining the bladder,* through the removal of the obstructing portion of the prostate.

The early operation is advised with the view of preventing infection of the kidneys and the deterioration of the patient's general health, on account of absorption from a septic bladder and the broken rest at night attendant upon frequent calls to urinate.

The prognosis of an operation is much better if done upon a man in good general health at the age of 60 than upon the same patient ten years later, after he has been worn out with suffering, and who has, in addition, diseased kidneys.

For hospital patients and those who have not the time or skill to give themselves and their catheters, the proper attention, immediate operation, is unquestionably preferable to temporizing. On the other hand, it is by no means unusual to see patients making themselves perfectly comfortable for years, sometimes in the presence of complete retention, by the use of a catheter.

With an intelligent man the author believes it better to explain the facts to him and allow him to decide for himself whether he wishes to be operated on immediately with a view of preventing the more serious condition which is almost sure to come later or to use the catheter and wait developments.

If the latter plan is adopted it is of the greatest importance that the patient should keep in close touch with the surgeon, and when it is found that the catheter must be passed more frequently, the urethra becomes irritable, and the cystitis is no longer easily controlled by bladder-washing the further delay of operation only imperils the patient's life and lessens the chances of the success of a prostatectomy.

PROSTATECTOMY.

On account of the development of the technique of prostatectomy by a number of different surgeons, there are today but three typical opera-

tions for the relief of enlarged prostate, each of which has its advantage in particular cases, and the surgeon of broad views will not invariably make use of one form of operation to the exclusion of the others, but from a careful study of the conditions will select the operation best adapted to the special case in hand.

An attempt has been made to formulate the indications for each type of operation, but before discussing this point it will be well to describe in detail the different forms of prostatectomy, viz.:—

(*a*) Intraurethral enucleation of the prostate with the finger, through an external urethrotomy incision.

(*b*) Enucleation of the prostate through a suprapubic incision in the bladder.

(*c*) Exposure of the prostate through a transverse incision in the perineum, and enucleation of the prostate under the guidance of the eye.

As to the death rate after operation there is not much choice between the different forms.

In a series of 800 cases collected by Watson and Cunningham of perineal prostatectomy the death rate was 6.01 per cent. Freyer's personal statistics were 7.03 per cent., although these figures are somewhat lower than those of other suprapubic operators, while the Mayo brothers report 100 cases equally divided between suprapubic and perineal operations in one year with a mortality of 10 per cent.

The writer believes that 10 per cent. is a fair estimate of the number of deaths for any surgeon who is operating on a large hospital material, and who is forced to operate on a good many desperate cases who have been allowed to get into such a condition by previous neglect and lack of treatment.

The mortality statistics of a large number of private patients applying for relief early in the disease before they become broken in health and with damaged kidneys would probably range about 5 per cent. or even lower. Hugh Young reports 128 consecutive cases without a death, but to get such excellent results a certain number of patients would have to be allowed to die without making the attempt to relieve them.

An interesting study of the statistics of prostatectomy was made by Tenney and Chase, who found that there is relatively more danger in operating on older men.

Cases.	Ages.	Mortality, per cent.
120	50-60	5.8
422	60-70	9.5
240	70-80	15.0

The first two named operations depend upon the anatomical fact that an adenomatous prostate, unlike a healthy gland, can be enucleated from

a definite capsule surrounding it, the urethra being torn across during the enucleation, but without any harmful result, for the mucous membrane of the base of the bladder formerly serving as the roof of the prostate falls down and applies itself like a skin graft to the walls of the cavity previously occupied by the enucleated prostate.

The opponents of the first two forms of operation urge that the ejaculatory ducts are torn across and destroyed and sterility follows. This is no doubt sometimes true, but in general the ejaculatory ducts are saved, for they empty into the urethra at the sides of the verumontanum and the rupture of the urethra occurs posterior to that point, but even if the ducts were always destroyed, at the age at which a man seeks relief from his troublesome prostate, the wish to rear a large and happy family does not enter much into his scheme of life.

A small, hard prostate made up chiefly of fibrous tissue can scarcely be enucleated without the aid of vision to direct the enucleation with scissors, and for that reason this class of prostate can only be removed by free exposure and dissection.

Intraurethral Enucleation of the Prostate through an External Urethrotomy Incision.

In this operation the prostate is enucleated from below, precisely in the same way as from above, in the case of a suprapubic prostatectomy.

The typical case for this operation is a prostate moderately enlarged and of medium consistency which is low down in the pelvis, so that on examining it with the finger in the rectum the finger can easily reach the upper margin of the prostate.

On account of the great rapidity with which the operation can be done, requiring only six or eight minutes to perform, it is especially indicated in very old and feeble individuals who are unable to stand the shock of any long operation.

Vesical calculi if they are small in size are no contraindication, as they can be readily extracted through the wound after the prostate is removed.

The healing of the wound is more rapid and the convalescence less prolonged than after the other forms of operation.

TECHNIQUE.

The patient is placed in the lithotomy position and a grooved staff is introduced into the bladder. An external urethrotomy is done and the knife is carried through the posterior urethra, incising the apex of the prostate.

The forefinger is introduced, exploring the prostatic urethra, and noting the amount of bulging of the prostate at the sides of the posterior

urethra, the presence of an enlarged middle lobe, and also if the bladder can be easily reached.

To begin the enucleation the mucous membrane at the apex of the prostate is perforated with the finger-nail and the finger inserted between the prostate and its capsule, breaking down the fibers which attach it to the gland. The finger is then swept around the lobe, freeing it entirely from all its attachments, and when it is felt to be loosened and lying free within the capsule the lobe is grasped with lithotomy forceps and extracted.

The opposite and posterior lobes should be treated in the same way. During all these manipulations an assistant makes strong counterpressure with the hand over the pubis. This not only steadies the prostate, but pushes it down within easy reach of the manipulating finger.

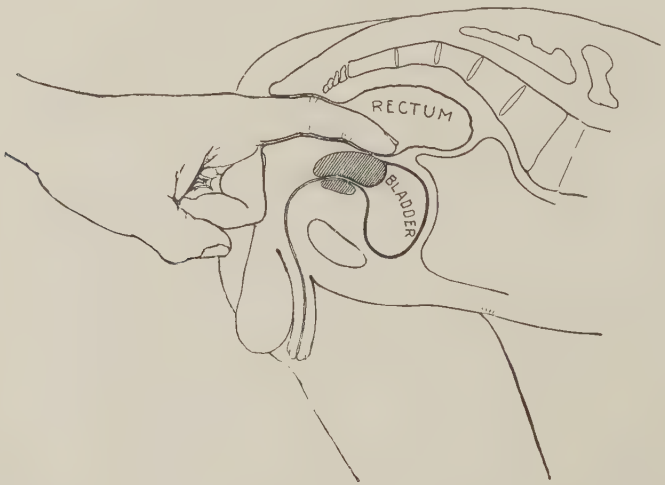


Fig. 174.—Senile hypertrophy of prostate. Finger in rectum easily reaches and outlines upper margin of prostate. Suitable for perineal intraurethral enucleation.

Oftentimes when not very large the entire prostate can be loosened up within the capsule and removed *en masse;* at other times each lobe has to be enucleated separately, and sometimes the prostate has to be removed by a species of *morcellement,* the individual adenomatous tumors being scooped out one at a time, until all of them are removed; this was the original plan of Bryson and practised by him as a general rule.

After the growths have been removed by the process of enucleation, the bladder should be thoroughly explored with the finger for a calculus.

The oozing, which seems to come from the mucous membrane, soon stops after irrigation of the bladder and wound with hot normal salt solution.

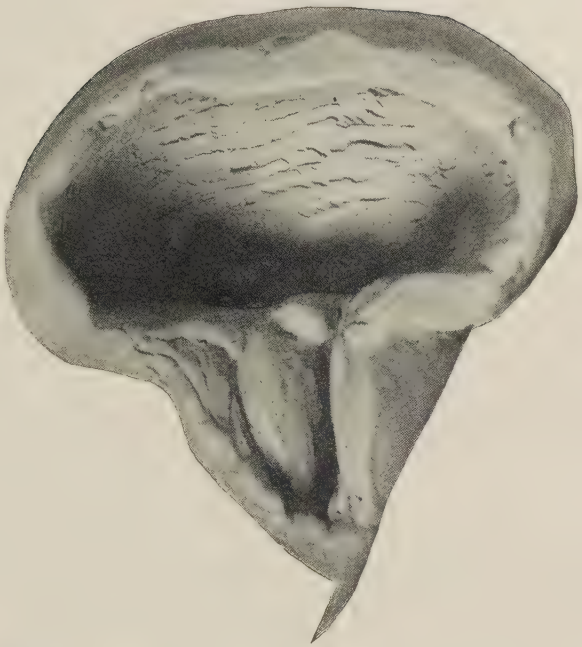


Fig. 175. — Prostatic hypertrophy. Considerable enlargement of both lateral lobes, but especially of the right; high prostatic bar; small nodule on right of the bar; deep bas fond. Favorable for perineal prostatectomy. (*Bransford Lewis.*)

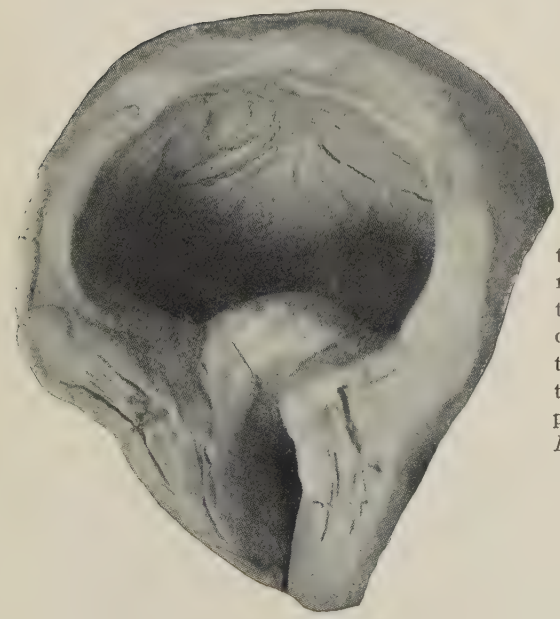


Fig. 176.—Prostatic hypertrophy. Moderate enlargement of both lateral lobes; thick, dense prostatic bar; deep bas fond; marked curvature of narrow prostatic urethra. Favorable for perineal prostatectomy. (*Bransford Lewis.*)

A 34 French soft-rubber catheter is then introduced through the wound into the bladder for the purpose of drainage, and gauze is packed firmly around it, and this pressure absolutely controls the hemorrhage.

If the field of operation were now examined with the finger, a large cavity would be made out, lying immediately below the vesical outlet, which formerly contained the prostatic tumors, and is only separated from the rectum by a thin wall.

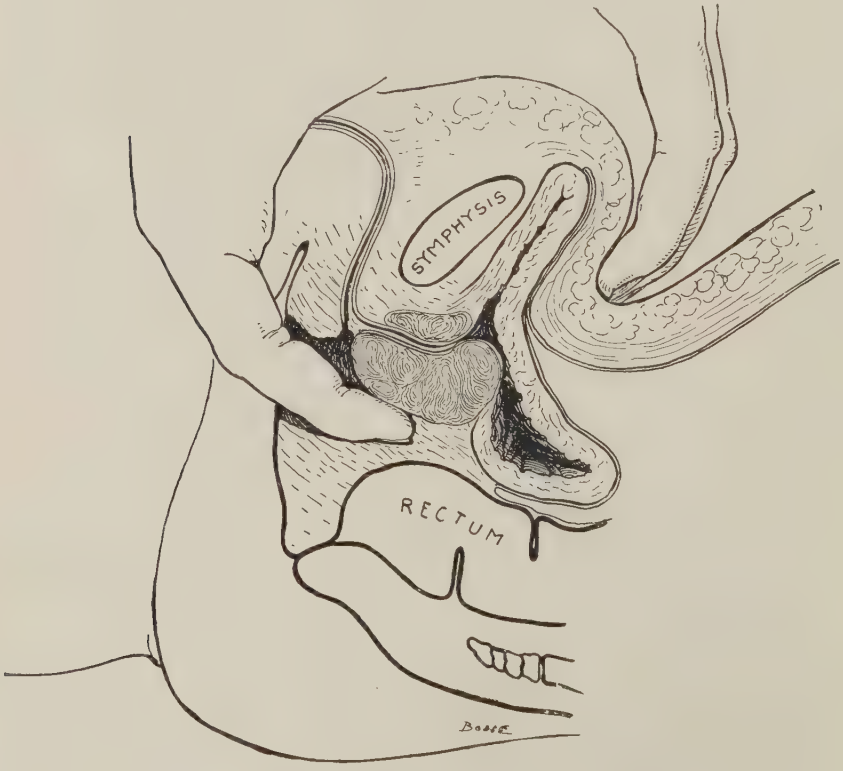


Fig. 177.—Perineal prostatectomy. Intraurethral enucleation with right forefinger. Left hand making counterpressure above pubes.

The floor of the urethra is generally found to be intact, and the mucous membrane forming the sides of the urethra hangs loosely in flaps against the outer sides of the cavity from which the growths have been removed.

These flaps, in the subsequent healing, either slough off and disappear or else become adherent to the walls of the emptied capsule like a skin-graft.

Fig. 178.—Prostate, weight 624 grains, removed by intra-urethral finger enucleation *en masse*. Author's case.

Fig. 179.—Prostate removed by intra-urethral enucleation with finger *en masse*. Author's case.

In other cases, where the whole prostate has been shelled out of the capsule *en masse,* the entire prostatic urethra has disappeared along with the prostate, and the new urethra is formed by a contraction and cicatrization of the walls of the old prostatic capsule.

It was formerly claimed that very large prostates could not be removed through a perineal incision, but it is surprising to find the facility with which enormous glands can be removed from below, provided an assistant will make firm counterpressure upon the abdominal wall, just above the pubes, with the fingers of the open hand.

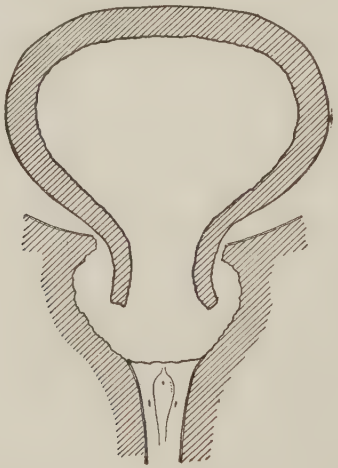


Fig. 180.—Flap of bladder, mucous membrane applying itself to sides of cavity, from which prostate has been enucleated either by perineal or suprapubic finger enucleation.

In careful hands injury to the rectum is not likely to occur and may be guarded against by putting one finger protected by a finger cot in the rectum as a guide to its proximity. Hemorrhage is never severe and can be controlled by firm packing around the tube.

AFTER-TREATMENT.

The postoperative treatment of prostatectomy requires the closest attention on the part of surgeons and nurses, for the conditions in the few days after the operation often determine the patient's fate.

To avoid the danger of suppression of urine, which causes 35 per cent. of the deaths (Watson and Cunningham), the best method at our disposal is the immediate and routine use of the drop method of **colonic irrigation** as suggested by Murphy.

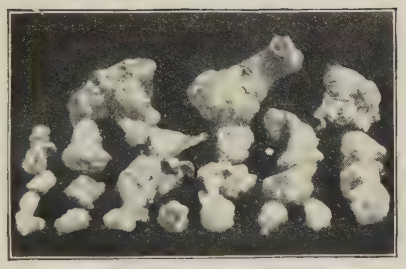


Fig. 181.—Hypertrophied prostate (adenomatous form) after enucleation by perineal prostatectomy. Weight, 1420 grains. Author's case.

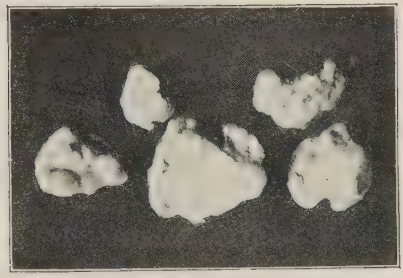


Fig. 182.—Hypertrophied prostate (adenomatous form) after enucleation by perineal prostatectomy. Author's case.

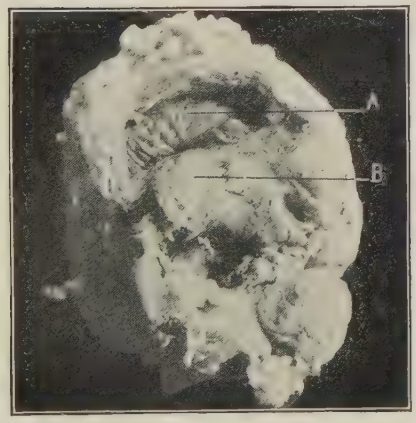


Fig. 183.—Post-mortem specimen of bladder after perineal prostatectomy. Author's case. *A.* Bladder. *B.* Cavity within prostatic capsule formerly occupied by prostate.

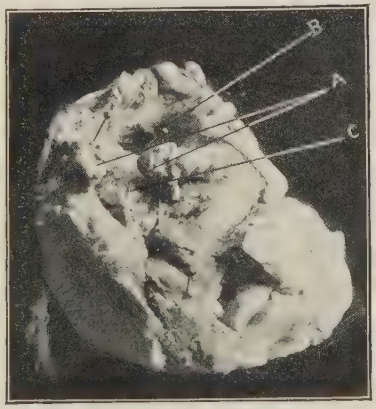


Fig. 184.—Post-mortem specimen of bladder after perineal prostatectomy. Author's case. *A.* Tags of mucous membrane forming sides of posterior urethra. *B.* Bladder. *C.* Cavity within capsule formerly occupied by prostate.

A soft-rubber catheter is introduced just within the anal sphincter and attached to a douche-bag filled with warm normal salt solution; by means of a clamp on the tube the flow is regulated so that from 40 to 60 drops are delivered each minute into the rectum. This quantity is immediately absorbed, leaving no residue lying in the bowel. To be absorbed, the solution must be kept warm, which can be done by hanging a hot-water bag outside the douche-bag. In this way several quarts of fluid can be taken up by the blood-vessels in twenty-four hours, and is the best stimulant to the kidneys and diuretic which we possess.

It may be continued until the kidneys begin to secrete freely[1] and for as long as the rectum retains it. Since establishing the practice almost as a routine of using the permanent catheter and bladder drainage as a preliminary to operation with the Murphy drip afterward, the author has had a notable reduction in his postoperative deaths from suppression of urine. Indeed, it might be stated that the tripod of safety in prostatectomy is preliminary drainage, rapid operation, and the Murphy drip afterward.

As an additional safeguard the patient should drink water freely, a tumblerful every two hours, as soon as he has recovered from his anesthetic.

Hypostatic pneumonia should be guarded against by making the patient lie on his side and turning him to the opposite side every two hours.

The packing of the wound should be loosened in forty-eight hours and a little removed each day; and if a stricture in the anterior urethra was divided, a straight sound should be passed down to the perineal tube. At the end of a week the perineal tube may be taken out permanently and the patient allowed to get out of bed and sit in a chair.

About the tenth day a curved sound, No. 30 French, should be passed into the bladder, and this must be done two or three times a week until the perineal wound heals. If this precaution is not taken the granulating surfaces in the prostatic urethra are apt to adhere together and the urethra becomes permanently occluded.

While in many cases it may not be necessary, still it is certainly safer for a sound to be passed at occasional intervals during the rest of the patient's life.

Suprapubic Prostatectomy.

During the developmental stage of prostatectomy the suprapubic route was the favorite one for approaching the prostate, but as the

[1] In one of the author's cases urinary secretion did not begin until thirty-six hours and in another one forty-eight hours after the operation. Both patients did well and recovered.

Fig. 185.—Prostatic hypertrophy. Bilateral enlargement, but no obstruction from that source; intravesical globular tumor, pedunculated, which obstructs in ball-and-socket-valve manner. Bottini inappropriate; suprapubic removal the operation of choice. (*Bransford Lewis.*)

Fig. 186.—Prostatic hypertrophy. Marked enlargement of both lateral lobes, and globular intravesicular tumor from posterior commissure. Removal of tumor and both lobes required; best accomplished through suprapubic route. Bottini inappropriate and inadequate. (*Bransford Lewis.*)

technique of the dissecting perineal operations was perfected by Continental surgeons, especially Proust and Albarran in France and Hugh Young in America, the fashion in practice for a time became to remove all prostates through the perineum.

The admirable work done by Eugene Fuller, of New York, and Freyer, of London, however, caused the pendulum to swing again, and today in France and Germany the perineal operation has largely lost its vogue and the suprapubic route is the one generally adopted.

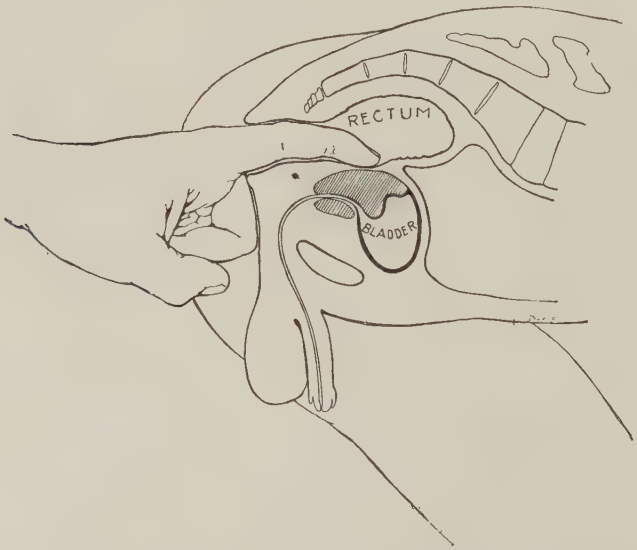


Fig. 187.—Senile hypertrophy of prostate. Finger in rectum cannot reach upper margin of prostate. Suprapubic prostatectomy operation of choice.

The typical cases for suprapubic prostatectomy are the enormous prostates or those enlargements of considerable size which extend high up in the pelvis and where the lobes project up into the bladder.

While some of these can be removed through the perineum, the upper portions of many of them are out of reach of the enucleating finger from below, and the logical route of attack must be from above, as was first pointed out by Watson in 1888.[1]

These cases may usually be recognized by rectal examination, for the examining finger cannot touch the upper margin of the prostate, but falls short of reaching the upper border.

[1] "Operative Treatment of Hypertrophied Prostate," F. S. Watson, 1888.

Fig. 188.—Prostate weighing 6¾ ounces causing complete retention for five years. Typical case for suprapubic prostatectomy, by which it was removed. Author's case.

A cystoscopic examination shows a large intravesical growth projecting upward in the bladder or perhaps only an isolated middle lobe standing upright like a ball valve.

The presence of large vesical calculi may also be considered a sufficient reason for adopting the high operation.

The mortality rate is very slightly higher than in the perineal operation, the amount of postoperative shock is greater, the convalescence and time of wound healing are more prolonged, and the patient is constantly bathed in his urine until urethral urination is re-established. As an offset to these objections, there is much less liability to subsequent incontinence of urine.

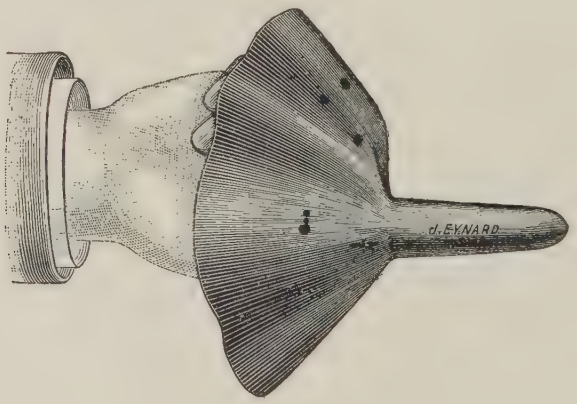


Fig. 189.—Rubber finger cot and shield for hand for use in prostatectomy.

Patients with fat bellies are not so well suited to this form of operation on account of the liability to subsequent necrosis and sloughing of the abdominal wound, with consequent sepsis.

The technique of suprapubic prostatectomy as done by Freyer differs in some minor points from Fuller's mode of operating, for the former surgeon endeavors to enucleate the prostate in one mass from its enclosing capsule.

The posterior urethra is torn across at the point of location of the verumontanum and removed with the prostate. The ejaculatory ducts are often destroyed, but in the majority of cases the ducts remain uninjured in the portion of urethra which is left behind.

Technique.[1]—The bladder is filled with water and the catheter left in the urethra.

With the patient in the Trendelenberg position the bladder is opened by a suprapubic incision and the forefinger of the left hand protected by

[1] "Surgical Diseases of the Genito-urinary Organs," Freyer, 1908.

a finger cot introduced into the rectum to push the prostate up toward the bladder and hold it steady during the manipulations. The mucous membrane over the most prominent portion of one lateral lobe is scraped through by the finger-nail and the true capsule of the prostate which lies within the enveloping sheath is at once reached.

Bentley Squier *inserts his finger into the prostatic urethra* and breaks through the mucous membrane at that point, claiming an easier access to the lines of cleavage by this approach.

The enucleation of the prostate and of its enveloping sheath is per-

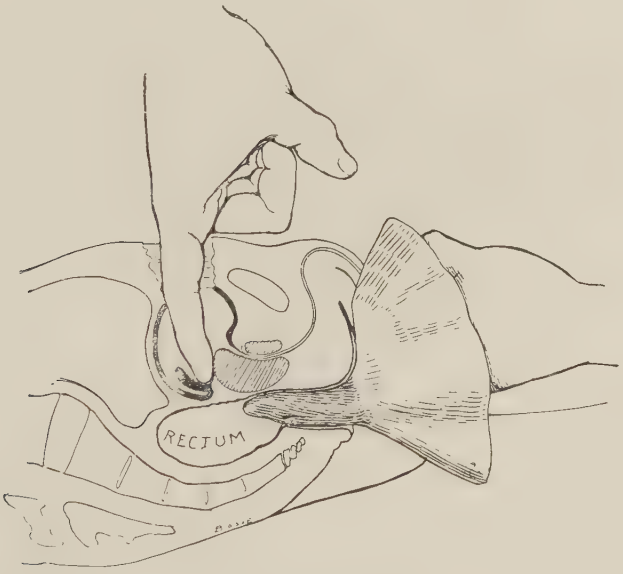


Fig. 190.—Suprapubic prostatectomy, right forefinger enucleating prostate and left finger in rectum making counterpressure.

formed by insinuating the finger-tip, in succession, behind, outside, and in front of one lateral lobe, thus separating the capsule from the sheath. The finger is thus swept in a circular fashion from without inward, in front of and to the inner side of the lobe, detaching this from the urethra, which is felt covering the catheter introduced before opening the bladder, and pushed forward toward the symphysis between the lateral lobes, which will, as a rule, have separated along their anterior commissure in the course of the manipulation. The other lobe is attached and treated in the same manner. The finger is next pushed well downward behind the prostate on the anterior surface of the gland and is peeled off the triangular ligament.

When the prostate is felt free within its sheath and separated from the urethra with the finger in the rectum aided by that in the bladder, it is pushed out of the bladder through the opening in the mucous membrane, which during the manipulation will have become considerably enlarged.

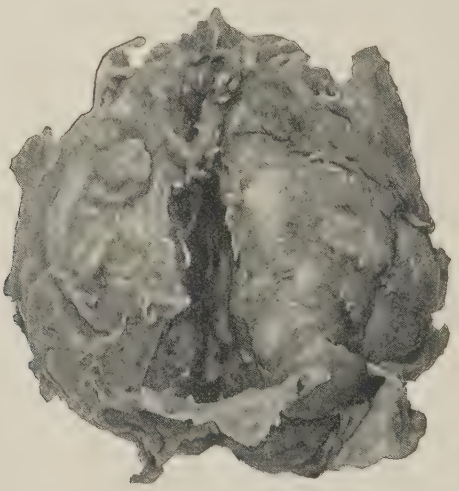


Fig. 191.—Prostate removed by suprapubic prostatectomy. Author's case.

The prostate, which now lies free in the bladder, is withdrawn by strong forceps through the suprapubic wound.

There is but very little bleeding, and that is arrested by pressing the walls of the cavity, formerly occupied by the prostate, together by the points of the fingers in the rectum and bladder, and the use of hot irrigations.

Fig. 192.—Freyer's suprapubic tube for bladder drainage after prostatectomy.

The bladder having been cleared of clots, a stout India-rubber drainage-tube is introduced through the suprapubic wound. Freyer regards the dimensions and management of this tube as of the utmost importance in the after-treatment of prostatectomy. The tube is 4 inches long, 1 inch in diameter, with a lumen of ⅞ inch, and provided with two large perforations or eyes at its end.

About one inch of the tube should project into the bladder, just enough for the side openings to lie completely within its cavity, but the tube must not enter the cavity of the prostate.

The bladder-wall contracts tightly around the tube, and all the urine escapes through it, and infection and cellulitis of the loose tissues of the prevesical space are prevented.

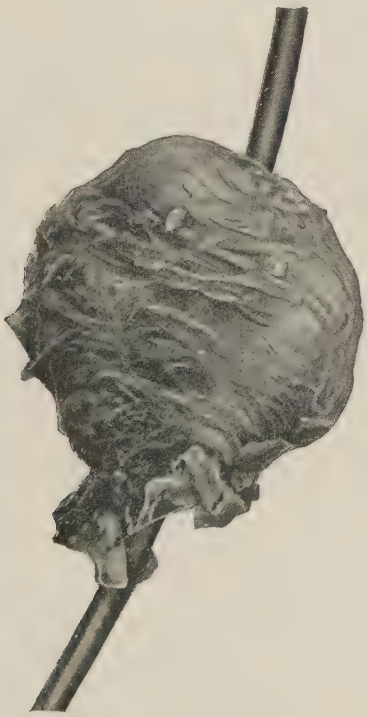


Fig. 193.—Prostate removed by suprapubic prostatectomy. Weight 1 ounce. Could also have been removed by intraurethral finger enucleation. Author's case.

The edges of the parietal wound are brought together around the tube by silkworm-gut sutures, one or two of which should pass through the recti muscles. Buried sutures are certain to be infected by the urine and should not be used. One suture should pass through the drainage-tube to keep it in position. The wound is covered with gauze and the patient's body swathed in absorbent dressings, which must be changed every four to six hours, when saturated with urine. The tube should be removed four days after the operation.

The bladder is irrigated twice a day through the wound, but no catheter is passed through the urethra until the suprapubic fistula has almost closed.

Attempts have been made in the Necker Hospital and elsewhere to drain the bladder by a permanent catheter in the urethra, but have always resulted badly, for patients develop urinary fever and abscesses. Freyer explicitly states that the cavity within the prostatic capsule must be left empty so that it may close down and heal, and anything inserted through it or into it will prevent this aim.

ACCIDENTS DURING OPERATION.

Opening the peritoneal cavity occasionally happens, particularly when the bladder is not sufficiently distended, for in old men the peritoneal fold is often relaxed and hangs lower than in young individuals. It is not a serious accident if the incision be repaired at once with fine silk.

Hemorrhage after enucleating the prostate generally ceases with hot irrigation of the bladder, particularly if accompanied by Freyer's manipulation of pressing together the apposing surfaces of the cavity from which the prostate has been enucleated, all round the vesical orifice between the tips of the fingers of the right hand, while the left hand makes counterpressure through the rectum, in the same way that a dentist presses the gum together after the extraction of a tooth.

In exceptional cases the hemorrhage is stopped by these simple means, and the cavity of the prostate and entire bladder must be packed with gauze, which is left in forty-eight hours. This does not obstruct the outflow of urine, which seeps out freely through the gauze.

Firm adhesions of the prostate to its capsule may require the insertion of retractors into the bladder, free exposure of its cavity, and their division with scissors; occasionally the urethra must be treated in the same way, and cut across when it does not tear readily.

Injury to the rectum must be guarded against constantly, by keeping one finger in the rectum during the process of enucleation; by knowing constantly the position of the enucleating finger and the degree of force exerted by it, laceration of the thin prostatic capsule into the rectum can be avoided.

AFTER-TREATMENT.

After the operation is completed it is desirable to put the patient in bed, with hot bottles to his feet as soon as possible.

If the pulse is weak or the kidneys are known to be damaged a pint of salt solution may be given at once by hypodermoclysis, and colonic irrigation by the Murphy drip begun and continued until urinary secretion has started, and water must be given freely by the mouth.

During the first twenty-four hours the patient should lie on his back; after this time he should be turned from side to side every two hours to prevent hypostatic pneumonia, but should not be allowed to move himself for fear of causing hemorrhage.

The bowels need not be opened for two or three days; then a saline cathartic or castor oil may be given.

The tube should be taken out on the fourth day and a smaller tube inserted into the bladder, and the wound in the abdominal wall packed around the tube with gauze soaked in 2 per cent. liquor aluminii acetatis. In this way the urine is kept from contact with the surface of the wound during its healing, and one great danger and occasional cause of death, viz., gangrene of the wound and general sepsis, is greatly minimized. There is always a good deal of leakage around the bladder tube, necessitating frequent changes of the absorbent dressings.

After the operation there is constant oozing of blood for forty-eight hours, and if it should be considerable in amount the foot of the bed may be elevated and gr. $\frac{1}{100}$ of ergotine given hypodermically.

Tympanites and abdominal distention are unfavorable signs, and are generally a portent of suppression of urine. The Murphy drip must be used at once; asafetida, gr. v every four hours, for its relaxing effect on the intestinal muscular fibers, given internally, and eserine, gr. $\frac{1}{40}$, and strychnine, gr. $\frac{1}{40}$ hypodermically every two to four hours for the same purpose.

If the tympanites be chiefly in the stomach, and is accompanied with dilatation of this organ and persistent vomiting, stomach-washing is called for.

The sutures should be removed from the abdominal wound on the eighth day and the patient encouraged to get out of bed soon afterward, for these old men easily become bedridden and sometimes die from a general failure of the vital forces.

The wound should be entirely healed in from four to six weeks, but urethral urination begins long before this time.

Prostatectomy by Means of a Transverse Incision in the Perineum and Enucleation of the Prostate under Guidance of the Eye.

This so-called dissecting operation was developed originally in France by the work of Proust and Albarran, and improved by Hugh Young, of America, and for several years was the operation of choice on the continent of Europe.

TECHNIQUE.

The first step in the operation consists in placing a 24 French Benique sound in the urethra to be used as a guide, as its introduction is difficult after the thighs have been flexed.

POSITION OF THE PATIENT.

The patient is placed in the exaggerated lithotomy position, lying on an inclined plane, with the thighs flexed upon the body and moderately

Fig. 194.—Exaggerated lithotomy position for Albarran-Young's prostatectomy.

separated, supported by special leg supporters attached to the table. The perineum should be so elevated that it is almost parallel with the floor.

Landmarks for the Skin Incision.—(*a*) *The Bulb of the Corpus Spongiosum.*—Its prominence can usually be seen under the skin, but by drawing the thumb backward in the median line its termination can be distinctly felt.

(*b*) *The Two Tuberosities of the Ischium.*—The perineal planes are divided layer by layer, and the three steps necessary may be considered as follows:—

SECTION OF THE PERINEAL PLANES.

(*a*) Section of skin, fat, and superficial fascia.

(*b*) Section of the perineal central tendon and exposure of the margins of the levator ani.

(*c*) Opening of the space "decollable inter-recto prostatique."

(*a*) *Section of Skin, Fat, and Superficial Fascia.*—An incision is made from one tuberosity to the other, curving slightly and passing two fingerbreadths in front of the anus.

The subcutaneous fat is incised. It is sometimes thick and sometimes scanty. At the extremities of the incision, one finds the ischiorectal fossa; here the incision is made deeply and freely. In the median segment it is made superficially and cautiously.

(*b*) *Section of the Perineal Central Tendon and Exposure of Margins of Levator Ani Muscle.*—Dissection with the scalpel, held transversely, soon exposes the perineal tendon,[1] which is divided transversely close to

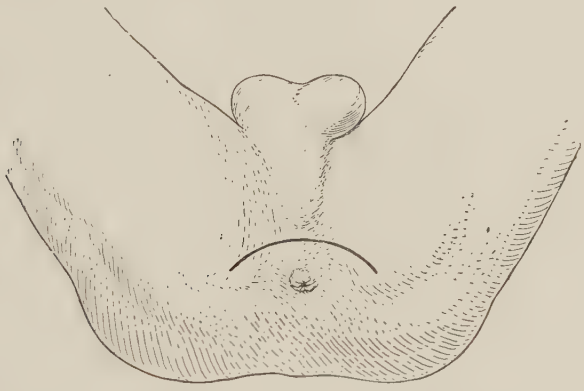


Fig. 195.—Line of incision for the Albarran-Young prostatectomy between the anus and the bulb, terminated laterally by the ischii.

the bulb. Firm retraction on the anus facilitates the exposure of the tendon.

The bifid retractor of Young is an excellent instrument, aids greatly in the exposure of the tendon, and greatly facilitates its division. This retractor is removed after the tendon has been cut.

After severing the central tendon the proper inclination to give the knife is of fundamental importance. It should be directed toward the umbilicus of the patient with a slight inclination; if held vertically it menaces the rectum; if horizontally, it may wound the bulb or the urethra.

After the central tendon has been divided in the median line, the

[1] The central tendon of the perineum is a fibrous point in the middle line of the perineum between the urethra and rectum, being about one-half inch in front of the anus. At this point four muscles converge and are attached, viz.: External sphincter ani, bulbocavernosus, and the two transverse perinei, so that by the contraction of these muscles, which extend in opposite directions, it serves as a fixed support.

bistoury divides some fibrous tissue of a thickness of some millimeters. Suddenly the median region gapes widely open. At this stage, an anterior retractor may be placed beneath the bulb and a posterior retractor, about two inches in depth, is inserted, by which the rectum can be pushed back. Traction upon these retractors enlarges the wound and puts the rectourethralis muscle, which appears in the depth of the wound as a small muscle band running anteroposteriorly, upon the stretch.

The rectourethralis is a short muscle with rather indefinite margins, which, as its name indicates, joins the rectum with the urethra. It is

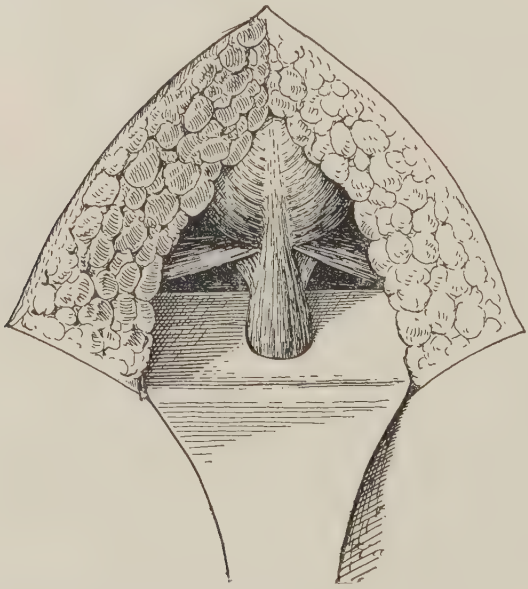


Fig. 196.—Exposure of bulb, central tendon, and levatores ani. Bifid retractor making tension on central tendon.

apparently responsible for the acute anterior flexure of the rectum which lies so close to the apex of the prostate and membranous urethra and which one finds in rectal examinations. In order to reach the membranous urethra and the apex of the prostate, it is necessary to divide this muscle.

A failure to cut these muscular fibers is responsible for the tears into the rectum which occur so frequently in this operation, for if downward pressure is made upon it with the finger or a retractor, the muscle does not yield, but its insertion into the wall of the rectum tears out and a laceration of the thin wall is caused.

To divide the rectourethralis muscle, it is grasped near its rectal insertion with anatomical forceps, making slight traction, and, with the

bistoury held almost horizontally, is cut in its anterior part. Puncture of the urethra may be avoided by using the sound, previously introduced, as a landmark.

(*c*) *Opening of the Space "Decollable Inter-recto Prostatique."*—As soon as the rectourethralis muscle is cut, a large cavity between the rectum and the prostate gapes widely. It is the space "decollable inter-recto prostatique." With the finger it is enlarged. Then the two fingers are introduced side by side and widely separated, thus widely opening up the space.

The aspect of the operative region is then the following: Behind are seen the anus and the external sphincter, from which the edges of the

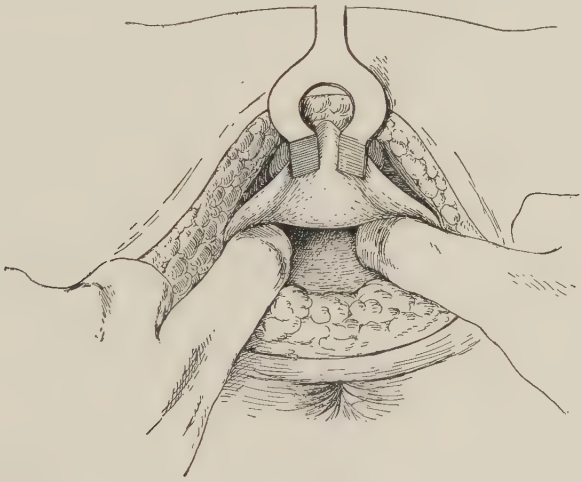


Fig. 197.—Enlarging with the fingers the space decollable inter-recto prostatique.

levator ani run in a forward direction, to be lost in the depths of the wound; in front the bulb attached laterally by the transverse superficial muscles. In the center a vast cavity, its posterior wall formed by the rectum, which appears smooth and shining, as if covered with serous membrane.

The anterior wall is formed by the prostate, also covered by a smooth shining membrane. At the bottom, if the dissection is carried to the extreme limit, the peritoneum of the *cul-de-sac* of Douglas.

The penetration into the space "decollable inter-recto prostatique" is the important point in exposing the prostate. The key to this space is the little rectourethral muscle, and as soon as this is divided the space is opened. If great care is not exercised, in the division of this muscle, to keep close to the membranous urethra but without opening it, the

dissection will be made below the posterior layer of the aponeurosis of Denonvilliers (obliterated peritoneal sac), between it and the rectum, instead of between the two layers of this structure, where is found the space "decollable inter-recto prostatique." The demonstration that the dissection has been properly made is the smooth, shining appearance, like serous membrane, of the rectum.

EXTIRPATION OF THE PROSTATE.

Steps:—

(*a*) Opening of the urethra and retraction of gland.
(*b*) Dissection of the capsule.
(*c*) Hemisection and extirpation of the lateral prostatic lobes.
(*d*) Extirpation of the median lobe.
(*e*) Perineal drainage and closure of wound.

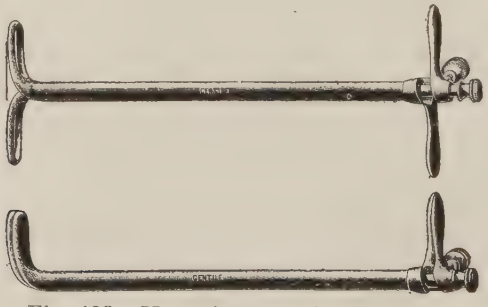


Fig. 198.—Young's prostatic retractor.

(*a*) *Opening of the Urethra and Retraction of the Prostate.*—After the membranous urethra has been exposed, by the division of the recto-urethral muscle, it is opened on the previously introduced sound, and the edges of the urethral wound caught up by silk guide sutures or Halsted forceps. The urethral sound is removed and the prostatic tractor (preferably Young's) introduced, closed, through the urethral wound into the bladder. As soon as the beak is free in the vesical cavity the thumb-screw, which fixes the blade in position, is loosened, blades rotated 180 degrees, and fixed by tightening the thumbscrew.

Albarran's or Young's posterior retractor is introduced into the space "decollable inter-recto prostatique." Traction upon the retractor placed within the bladder makes the gland emerge between the levator ani muscles, giving a splendid exposure of the entire posterior surface of the prostate.

(*b*) *Dissection of the Periprostatic Capsule.*—Albarran incises the capsule of the prostate in the median line from the membranous prostatic junction to the apex of the prostate.

Young makes two incisions, on either side of the median line, 1.5 cm. deep, with the object of preserving the ejaculatory ducts; then by dissection, with a dissector or the closed points of blunt curved scissors, the capsule is gently stripped off the gland.

This separation should be carefully made on the lateral surfaces,

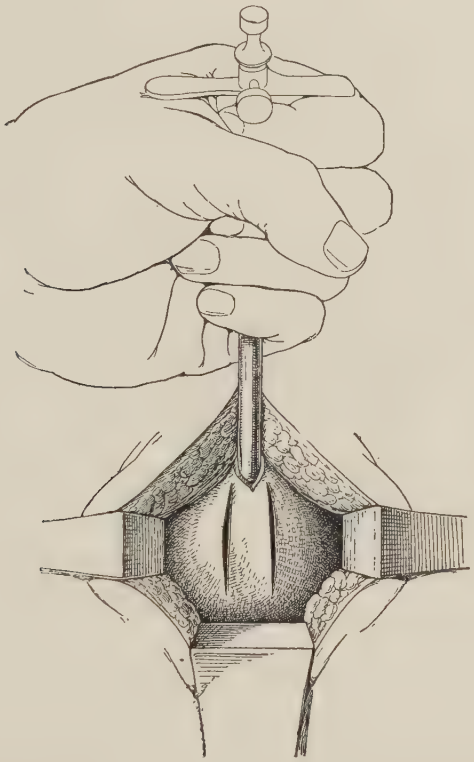


Fig. 199.—Young's retractor introduced, blades separated, traction made exposing posterior surface of prostate incision in capsule on each side of ejaculatory ducts.

which are vascular regions, and carried as far forward as possible, just in front of the urethra, nearly in the median line.

It is sometimes necessary for the lateral freeing of the capsule to seize each half with toothed forceps and make traction away from the gland.

(*c*) *Hemisection and Extirpation of the Prostate.*—The prostate is incised along its entire length, in the median line. This incision divides the prostate into two lateral halves. It is carried down to but not into the urethra.

Young hemisects the prostate by two incisions down to the urethra, leaving a bridge of prostatic tissue, containing the ejaculatory ducts, and the extirpation of the prostatic lobe is commenced from within outward, and terminates from without inward. The urethra is dissected, along its entire length, from the prostatic lobe, with scissors. The separation is made comparatively easy by a sort of plane of cleavage,—inter-uretero prostatique.

Often the finger answers the purpose better, and it is usually easy to find the lines of cleavage unless the prostate is very hard and fibrous.

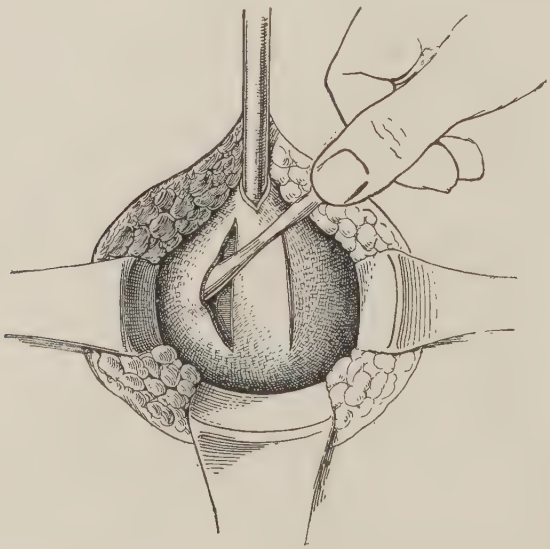


Fig. 200.—Beginning the enucleation by separating the capsule from the prostate.

After the urethra has been liberated from the lobe, the lobe is drawn toward the opposite side; its external surface is freed as far as possible; then the finger, sweeping around the lobe, from without inward, liberates it entirely and pushes it backward.

The superior surface is disengaged with great facility from the bladder. The freed lobe now rests hanging from the genital pedicle—vasa deferentia and vesiculæ seminales.

Albarran does a double vasectomy in the scrotum to prevent epididymitis.

(*d*) *Median Lobe.*—After the lateral lobes have been removed, the prostatic tractor is removed. The finger is inserted through the urethral wound into the bladder. Pressure upon the median lobe everts it, and it is removed with curved scissors.

(*e*) *Perineal Drainage and Closure of Wound.*—Following the enucleation of the median lobe, a perineal drainage-tube 32° F. is passed through the urethral wound into the bladder. After being properly adjusted it is sewn to the upper angle of the wound with a single ligature.

A large-caliber drainage-tube should always be provided, as a small tube may easily become plugged by blood-clots, and may necessitate removal of tube before they can be removed, whereas when the same conditions occur in a tube of large caliber they can generally be re-

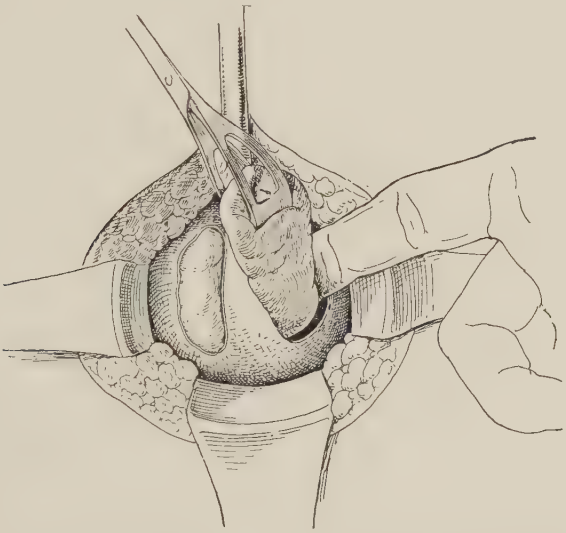


Fig. 201.—Enucleation of lateral lobes with finger while grasped with forceps.

moved with the aid of a Janet-Frank bladder syringe without removal of the tube.

A strip of gauze is packed snugly into the prostatic cavity and the free end of the strip is brought down through the outer wound, which it should not fit tightly, for too much pressure against the rectal wall may produce sloughing and lead to a fistula.

Before closure of the wound, the rectum should always be examined for lacerations, which, if found, should be repaired with a double row of "intestinal" sutures.

The levator ani muscles should be approximated with a single heavy catgut suture. This procedure is of great value (Young).

The extremities of the skin wound are partially closed with sutures, leaving a small area in front for the tube and gauze drains.

AFTER-TREATMENT.

The gauze drain is removed within twenty-four to thirty-six hours after the operation, and is not usually reapplied.

The length of time for which the tube drains the bladder varies with different operators: Young removes it in twenty-four hours; other operators, in about a week.

The patient should be placed in a chair during intervals of the day, as soon as tubes have been removed.

Fig. 202.—Enucleation of middle lobe by hooking finger over it and forcing it down into perineal wound.

Urotropin is administered early, and water is given in abundance.

The bladder is irrigated through the perineal tube twice daily with sol. oxycyanide of mercury, 1 : 4000.

In this operation the use of sounds is not necessary subsequently.

From the foregoing description it is evident that the technique of this operation is complicated and difficult and requires a number of rehearsals upon the cadaver before it can be attempted upon an old man.

Although the brilliant technique of Hugh Young enables him to complete the operation in fifteen minutes, with most surgeons it re-

quires a far longer time to perform than either of the forms of finger enucleation.

In addition to the length of time required, there is always the danger of wounding the rectum.

If vesical calculi are present they may be overlooked more easily

Fig. 203.—Prostate removed by perineal operation with Young's technique. Author's case.

than with the suprapubic route, and sometimes a middle lobe offers difficulties in the way of its removal, especially the pedunculated ball-valve form.

Although the patient can get out of bed within a few days after operation, the convalescence is slow, on account of the large wound in the perineum, which requires a long time to granulate.

For these reasons the operation is no longer as popular as it was five years ago, even in France, where it originated, the suprapubic operation having very largely superseded it.

The only advantage which can be claimed for it to counterbalance the difficult technique, length of time required to perform, and liability of wounding the rectum is the possible greater chance of preserving the ejaculatory ducts. As previously stated, these are frequently not destroyed by the other enucleations, and, even if they were, it is but a matter of little moment at that time of life.

The operation, however, has unquestionably one field of usefulness, and that is in the small, hard, fibrous prostates which are so adherent to the capsule that they can hardly be enucleated by the finger. This form of prostate can readily be removed by free exposure of the gland and cutting it away from its adherent capsule by scissors and blunt dissection.

Results of Suprapubic and Perineal Prostatectomy.—At the time that the operation of complete removal of the prostate first came into prominence the objection was raised by Guyon, Socin, and Thompson, on theoretical grounds, that, even though the obstructing prostate be removed, the contractile power of the bladder has been so much impaired that the patient will be incapable of spontaneous urination after the operation. The tabulated results of hundreds of prostatectomies, however, now demonstrate that in 90 per cent. of the cases restoration of the bladder function does take place, and that patients who were previously dependent upon the catheter are enabled to urinate voluntarily again.

No operation in surgery shows more gratifying results than a successful prostatectomy. After the operation and recovery the patient has unbroken sleep; he can take up his social and business obligations without being forced to interrupt the proceedings every little while to pass the catheter, and he gains weight, strength, and mental cheerfulness.

With the desperate cases who were suffering from chronic urinary fever, from absorption, and who for months have been afflicted with broken rest, dyspepsia, fever, and emaciation, prostatectomy is veritably a life-saving operation, and the change to normal conditions again is most striking.

In order to avoid the danger to life and to insure complete restitution of the bladder function, as has been previously pointed out, early operation is demanded, and the patient should not be allowed by the family medical adviser to get into a condition which in itself is sure to cause death, and which can be averted at a very slight risk by timely operation.

BOTTINI'S OPERATION.

Bottini's operation consists in burning channels through the enlarged prostate by means of a specially devised instrument, heated with

the electric current, and introduced into the bladder through the urethra. The instrument was devised by Bottini, of Pavia, Italy, and used by him for over thirty years, but never became popular until Freudenberg, of Berlin, made some alterations, which added to its usefulness.

Description of Instrument.—The instrument is shaped like a lithotrite, and is provided with a thin platinoiridium blade, which is concealed when the instrument is closed, and is moved backward or forward in a slot in the shaft by turning a wheel at the end of the instrument. This blade is heated to a white heat by means of an electric current conducted to it from a storage battery, through a cord attached to the extreme end of the instrument. All parts of the instrument, except the blade, are prevented from becoming heated by a stream of cold water, which constantly circulates through it.

Technique of Operation.—The operation can be done without a general

Fig. 204.—Bottini's instrument, as modified by Freudenberg.

anesthetic, simply using a 4 per cent. solution of cocaine injected into the posterior urethra.

In many cases, however, general anesthesia is desirable, and nitrous oxide, ether, or spinal anesthesia may be used, depending on the general indications.

The bladder is first washed with boric acid solution, and is filled either with the solution or with air before introducing the instrument.

Bottini's instrument is introduced into the bladder and hooked up against the projection of the middle lobe. The cold-water stream is turned on, and when everything is in readiness the electric current is switched on, a pause of ten seconds is made for the blade to become hot, and then the wheel is slowly turned, causing the red-hot blade to slide out of its place of concealment and slowly burn its way through the tissues of the prostate. After the incision has been made deep enough the wheel is reversed, and the blade slid back into its place of concealment, charring for a second time the tissues of the incision, and then the electric current is turned off.

To secure a thorough charring of the tissues the cuts should be made slowly, allowing about ten minutes for each incision.

During the process of burning, the situation of the beak should be watched, by keeping a finger in the patient's rectum.

After the cut through the posterior lobe is made, it is customary to

make two others, in an oblique direction posteriorly and to the right and left sides.

The *length of the incisions* depends upon the size of the prostate, but, as a rule, three centimeters are sufficient for the posterior cut and two centimeters for the lateral cuts.

The *after-treatment* consists in keeping the patient in bed for a few days and administering urotropin, gr. viiss *t. i. d.*, or salol, gr. v *t. i. d.*, to sterilize the urine, and strychnine, gr. $\frac{1}{30}$ *q. s. h.*, if the detrusor muscle is weak or atonic.

Severe tenesmus and desire to urinate are controlled by morphine, gr. $\frac{1}{4}$ to $\frac{1}{2}$, suppositories.

As retention nearly always follows the operation, either immediately or later, from the swelling of the burned surfaces, Bottini and Freudenberg advise the use of the permanent catheter in preference to passing an instrument; less irritation is caused by the continued presence of the catheter, and there is no danger of tearing open the freshly burned surfaces.

Bladder-washing is only required in the presence of severe cystitis, and it is not necessary to pass sounds, as the cuts show no tendency to close up. Hemorrhage is a rare accident, but can be controlled by the presence of a large-sized catheter tied in the bladder.

The sloughs usually separate about the eighth to the fourteenth day, and some slight bleeding occurs, and if the operation has been successful in severing the obstruction the urine begins to flow freely.

The maximum of improvement is not attained, however, until after four weeks have passed, as by that time the bladder has recovered its tone to some degree, and the cicatrices in the prostate, formed by the healing of the incisions, have begun to contract and open up the passage.

Selection of Cases.—Since the improvements in prostatectomy Bottini's operation has been practically abandoned, but still has a limited field of usefulness in the cases to which prostatectomy is not applicable.

As an anesthetic can be dispensed with, and the operation is accompanied with but little shock, and is, therefore, comparatively free from danger to life, it is particularly adapted to old men who are too debilitated to stand the severe ordeal of a prostatectomy.

Bottini's operation seems peculiarly suitable for the small, hard, fibrous prostates where there is a decided bar at the neck of the bladder, which are difficult to enucleate.

The large adenomatous prostates the size of an apple or larger are better treated by complete enucleation if the patient's general condition will admit of a prostatectomy, and with the suitable proper pre-

liminary treatment nearly all these patients can be so improved that they can stand a prostatectomy.

A reference to the mortality statistics following shows that the death rate is as high after Bottini's operation as following prostatectomy, and, besides the danger to life in many cases operated on by Bottini's method, the obstruction is not relieved or else returns.

On account of the uncertain result and comparatively high mortality, Bottini's operation today is only done in very exceptional cases.

Results as shown by statistics collected by Burckhardt from patients operated on by Wossidlo, von Frisch, W. Meyer, Stockmann, Freudenberg, and Emil Burckhardt:—

No. of cases.	Cured and improved.	Without result.	Died.
960	73 to 77 per cent.	14 to 18 per cent.	7 to 10 per cent.

CHETWOOD'S OPERATION.

Chetwood's operation is a modification of Bottini's and consists in burning furrows in the prostate with a special instrument devised by him, introduced into the bladder through a perineal incision.

Keyes and Chetwood claim for it the advantages of permitting digital examination of the obstructing prostate, the accurate placing of the instrument in position, and subsequent adequate drainage through the perineal incision.

The surgeon undertaking Chetwood's operation can, at any time during its course, convert it into a perineal prostatectomy and enucleate the entire prostate.

PALLIATIVE OPERATIONS.

In these operations no attempt is made to remove any portion of the prostate. They are done for the sole purpose of draining the bladder, treating the cystitis, and avoiding catheterization.

The bladder may be drained by means of a

(*a*) Perineal opening. (*b*) Suprapubic cystotomy.

The perineal incision is the operation of choice when it is desired to drain the bladder *temporarily* for the sake of giving a respite to the urethra which has been irritated by the hourly passage of a catheter, or to remove blood-clots from the bladder which have originated from hemorrhage into its cavity.

In cases of severe and obstinate cystitis the perineal opening and continuous drainage serve to clear the bladder from the thick mucopurulent urine and to restore the vesical mucous membrane to a healthy state and the urine to its normal *acid* reaction.

The perineal incision is a very slight operation, especially if done under cocaine inside and under the skin of the perineum, or nitrous oxide anesthesia.

The prostatic urethra is stretched and dilated with the finger at the same time, and a large catheter is introduced through the wound and kept in the bladder for from one to three weeks, draining it of its residual urine and allowing it to be washed out and kept clean and aseptic.

The drainage of the bladder gives great comfort. The patient is not aroused from sleep every few minutes to pass water. The tenesmus and pain on urination are no longer felt, the cystitis subsides, the prostatic edema lessens, the secretion of urine becomes freer, and the urinary fever and toxemia subside. After a week or two of drainage and the patient's general condition has greatly improved, the perineal opening can be utilized, to enucleate the prostate by means of the finger. It only requires a whiff of ether or nitrous oxide, and in two minutes the prostate can be removed by the intraurethral enucleation method, and the case subsequently be treated on the lines laid down for a prostatectomy.

In cases which are better adapted to a suprapubic prostatectomy the preliminary drainage may be conducted from above.

Suprapubic Cystotomy.—An opening made into the bladder above the pubes gives an opportunity to inspect the cavity of the bladder and remove a calculus if present, and if the stone happens to be in a saccular dilatation it can never be found in any other way.

As the condition of these patients is always desperate, and the operation is only undertaken as a last resource, it is important to avoid giving a general anesthetic, if possible.

Rovsing therefore uses local anesthesia, by means of cocaine solution injected under the skin over the bladder, which gives enough insensitiveness for the purposes of the operation.

The suprapubic fistula answers very well as a permanent opening and is more easily managed by the patient than the perineal opening. A Pezzer catheter, No. 25 French, is arranged to pass through the fistula, in the abdominal wall, into the bladder, siphon off the urine, and allow it to flow into a reservoir under the clothing. The patient wearing such an apparatus is able to be up and about, even to take long walks and enjoy a fair amount of activity.

In every case of enlarged prostate, however, rather than allow the patient to go indefinitely with a permanent suprapubic fistula, it is far better to enucleate the prostate with the finger through the supra opening, as soon as condition will allow it.

In cases of suprapubic drainage a frequent cause of death is gangrene of the suprapubic wound and general sepsis, and for that reason, where the permanent catheter cannot be tolerated in the urethra and drainage through an incision must be employed as a preliminary to prostatectomy, the author prefers the perineal route.

CHOICE OF OPERATION IN HYPERTROPHIED PROSTATE.

The perfection of the operative technique, as well as the improvement in the preliminary and after- treatment of prostatectomy, has placed the surgeon in a different attitude toward early operation from the stand which was taken a few years ago.

There are certain conditions which differ in each individual, and which have to be carefully considered before selecting the operation which seems most applicable to the case in hand.

POINTS FOR CONSIDERATION.

I. General Conditions.—(*a*) The age of the patient.

(*b*) The state of his general health.

(*c*) The condition of his sexual powers.

(*d*) The state of his kidneys.

(*e*) The amount of atheroma in the arteries.

II. Condition of the Prostate and Bladder.—(*a*) The size and density of the prostate.

(*b*) The form of the obstruction: whether it is in the form of a bar across the vesical outlet, a tumor deflecting the urethra, or a mass the size of an orange filling up the pelvis.

(*c*) The condition of the bladder in relation to its atony or hypertrophy.

(*d*) The quantity of residual urine.

(*e*) Catheterization, its ease, or if attended with pain and bleeding, and its necessary frequency.

(*f*) The severity of the accompanying cystitis.

III. Complicating Conditions.—(*a*) Vesical calculus.

(*b*) Stricture.

(*c*) Diabetes.

For the better selection of an operation it is useful to adopt the classification of prostatic cases suggested by J. William White.

Class A.—Patients with moderate enlargement of the prostate, who suffer little or no pain, and with clear residual urine to the extent of three or four ounces. Such cases can be subjected to prostatectomy with the minimum risk to life. The patients, however, are seldom willing to

submit to early operation, with a view of preventing a worse state, but prefer to temporize until, thus, difficulties increase and they come into Class B.

Class B.—These patients suffer with marked obstruction from the prostatic overgrowth at the vesical outlet. The prostate ranges in size from one and one-half inches in diameter to three inches (about the size of a lemon). The residual urine may be eight or ten ounces in amount, or there may be complete retention. The cystitis is marked, and the urine is purulent, ammoniacal, and fetid, and operative interference of some kind is clearly indicated.

If the patient is strong and vigorous, with active sexual powers, free from atheroma, with sound kidneys, and if the hypertrophy is glandular in character, causing the prostate to be soft and elastic and of large size, prostatectomy in most cases is followed by complete restitution of the bladder function.

The conformation and relation of the prostate to the bladder will determine whether it is to be approached by the perineal or suprapubic route.

Class C.—In this class the patient is old and very feeble, with marked atheroma and diseased kidneys. The prostate may range from two inches in diameter to the size of a small orange. Retention of urine is nearly or quite complete, and catheterization is difficult and painful.

Prostatectomy, while very much more dangerous than in Class B, might still be undertaken with hopes of success, and it is astonishing to see how well such an individual will stand a rapid prostatectomy, provided he has had a week or two of preliminary bladder drainage.

Class D includes the desperate cases with enormous prostates and excessive cystitis. The bladder is dilated and saccular, the retention complete, and catheterism difficult. These patients are advanced in years, and suffer from chronic urinary fever. The kidneys are diseased, and atheroma is extreme. Any surgical operation is attended with great danger, but the patients' suffering is so great that they are willing to accept any risk for the sake of relief.

In these cases the only operation which could be endured would be the establishment of permanent drainage of the bladder through a suprapubic fistula under local anesthesia, and after some weeks or months a prostatectomy through the existing fistula might be undertaken with some chance of success.

Diabetes is regarded as debarring all operations unless catheterization is impossible. In such cases permanent drainage through a suprapubic fistula affords the best means of relief.

CARCINOMA OF THE PROSTATE.

The importance of cancer of the prostate has only been appreciated since the operations for hypertrophied prostate in old men have come into general use. Albarran and Hallé state that 14 out of every 100 prostates removed at operation show evidence of carcinoma.[1]

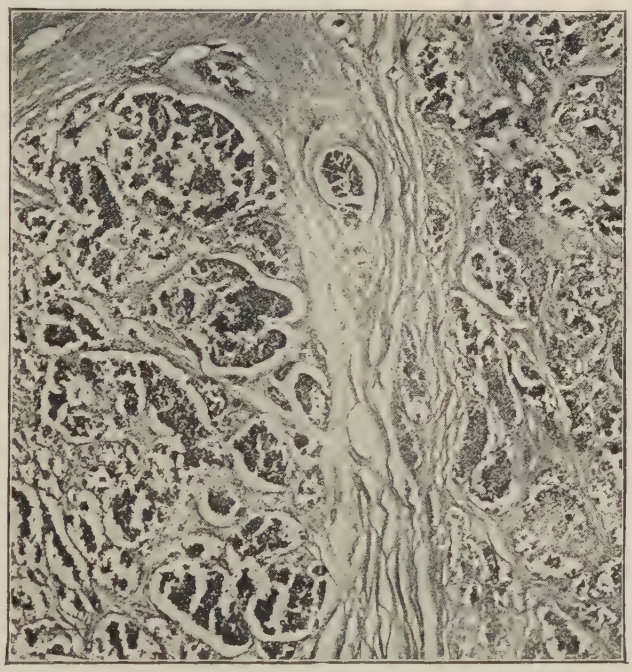


Fig. 205.—Adenocarcinoma of prostate, showing epithelial nests.

Carcinoma may originate *de novo* in a normal prostate, but it usually occurs as a degenerative change in an ordinary adenomatous hypertrophied prostate. Clinically the disease may occur as a small area of stony hardness which merges imperceptibly into the adenomatous hypertrophy of the gland. After existing for some time in this stage it slowly involves the whole gland, filling up the entire prostatic capsule, and finally the carcinomatous tissue bursts through the capsule and spreads into the pelvic cellular tissue surrounding the vesiculæ seminales and extending to the lateral walls of the pelvis and space of Retzius.

[1] Frank Kidd: "Urinary Surgery," London, 1910.

Instead of spreading by local extension a general metastasis may occur, with extensive deposits in the bones, lungs, or lumbar lymphatic glands.

SYMPTOMS AND COURSE.

As long as the carcinoma is confined within the prostatic capsule the symptoms are those of an enlarged prostate and are obstructive in character, but are more severe and run a more rapid course.

The disease may progress rapidly, with a duration of six months or a year, but in other cases the course is very chronic and may last three or four years or even more. The obstruction to urination becomes greater, and the patient dies from chronic urinary fever or infection of the kidneys, or from the cachexia induced by extensive secondary deposits.

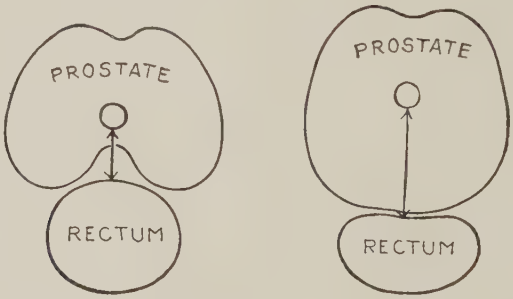


Fig. 206.—Differential diagnosis between senile hypertrophy and carcinoma of prostate, showing thickening of posterior lobe in carcinoma.

DIAGNOSIS.

When the cancerous growth consists only of a small nodule imbedded in the adenomatous tissue of a hypertrophied prostate, the diagnosis is only possible by a microscopic examination of the prostatic tissue removed at operation, and every hypertrophied prostate which is taken out should be subjected to this diagnostic test, for by the gross appearance alone of a prostate it is impossible to decide if it be simple adenoma or complicated by carcinoma. The accompanying picture of a prostate illustrates this very well, for to all appearances the prostate is a purely benign growth, and only upon microscopic examination was it found to be otherwise.

When the growth is larger a stony nodule may be felt in the prostate on rectal palpation, and if more extensive the prostate is irregularly enlarged, nodular, and of a stony hardness, and, instead of being freely movable on bimanual examination, is firmly fixed to the surrounding tissues.

In certain cases masses of enlarged lymphatic glands may be felt, sometimes at remote distances.

Geraghty has called attention to a simple means of making a diagnosis. A sound is introduced into the urethra and the surgeon's finger

Fig. 207.—Adenocarcinoma of the prostate removed by suprapubic prostatectomy. Operated twelve months ago and still free from recurrence. Author's case.

in the rectum to estimate the amount of thickened tissue between the posterior surface of the prostate and the urethra.

In a simple adenomatous prostate the bridge of tissue is very thin, but in a cancerous enlargement the amount of tissue between the finger and the sound is very much thickened and often stony hard.

Kidd describes a peculiar sensation which is felt when a sound or cystoscope is passed into the bladder through the urethra which he describes as a dry grating, as the instrument is gripped in the deep

urethra. Cystoscopic examination fails to disclose any characteristic change which would not occur from a hypertrophied prostate, unless in the late stages, when the growth has perforated into the trigone and formed an ulcer.

When the ulcer begins to break down, the author has observed a deep cavity in the substance of the prostate, bleeding freely on rectal examination.

TREATMENT.

In many cases of hypertrophied prostate which after enucleation showed a carcinomatous nodule, the removal has been complete and the patients have lived a long time without showing any recurrence. This fact may be well cited as an additional reason for advising early operation in cases of hypertrophied prostate.

After the disease has progressed to a point where it is still limited to the capsule of the prostate, Hugh Young has devised an operation by which the urethra, prostate, a portion of the bladder, and the vesicles are removed in one piece by dissection through a perineal incision and the cut urethra afterward united to the bladder.[1]

To be successful the patient must be in good condition to stand a protracted operation, and the disease must not have extended beyond the prostatic capsule.

As most of the cases apply for relief after the chance of successful operation has gone by, the surgeon must content himself with palliative treatment, deferring the catheter-life as long as possible to avoid the inevitable cystitis, and when the catheter no longer relieves by establishing a permanent suprapubic fistula for drainage.

[1] Johns Hopkins Reports, 1906.

CHAPTER XV.

TUBERCULOSIS OF THE PROSTATE.

The prostate is involved in nearly every case of genitourinary tuberculosis. Of 26 cases of tuberculosis of the prostate reported by Socin, in 24 of them other genitourinary organs were affected and only in 2 did the genitourinary apparatus escape. In these two instances the lungs and bones were the seat of tubercular deposits.

Although Sir Henry Thompson denied that the prostate could ever be the seat of *primary tuberculosis,* later investigators have proved conclusively that it may be, and Desnos and Krzwicki even go so far as to state that, in their opinion, in most cases of genitourinary tuberculosis the prostate is the organ which is first infected with tubercle bacilli, and from that focus the infection subsequently travels to the adjacent structures. This point is important to bear in mind in connection with the operative treatment, which will be considered later.

The *time of life* at which tuberculosis is most apt to fasten upon the genital organs is that period at which sexual activity is most highly developed, and consequently we find that our patients are usually between 20 and 45 years of age.

Predisposing causes play an important rôle in the etiology of tuberculosis of the prostate. Anything which induces prolonged and oft-repeated congestion of the posterior urethra weakens the resistance of the tissues; consequently, a tubercular outbreak is more liable to occur in the person of a young man who has practised some form of sexual abuse or has been the subject of a prolonged attack of gonorrhea of the posterior urethra. But this in itself is not sufficient to cause the disease, and, to bring this about, the tubercle bacilli must be actually introduced into and develop in the substance of the gland.

As to the **modes of infection,** the micro-organisms are most frequently brought to the prostate in the blood-circulation, often from a tubercular deposit in some distant organ. In other cases they may be taken into the body through the respiratory or alimentary tracts, and, passing along with the blood-current, be ultimately deposited in the prostate.

The inoculation of bacilli, however, may be direct, and be occasioned by an infected catheter or through coitus with a tubercular female, or the prostate may be infected by a process of extension from some neighboring organ.

PATHOLOGY.

A tuberculous deposit takes place in the substance of the prostate, and either one or both lobes are affected. The tubercular nodules are multiple from the beginning, or else soon become so, and they enlarge until several coalesce, when they break down and form abscesses.

Fig. 208.—Tuberculosis of prostate. Margin of caseation.

Unless removed by operation, the pus bursts through into the rectum or urethra or even the hypogastrium, and multiple fistulous tracts are formed. In rare instances the cheesy mass becomes the seat of calcareous changes, or the fluid portion of the mass is absorbed and the residue is encapsulated, and a healing of the lesion results.

It is important to note that the bladder and seminal vesicles are always involved sooner or later in the course of the disease. The epididymis is also affected, although in many cases this organ is the first attacked, and the infection extends to the prostate subsequently.

SYMPTOMS AND COURSE.

If the process begins in the central part of the prostate, no definite symptoms are caused; but if the nodules are located superficially, and cause a bulging of the prostate toward the rectum, a sense of weight in the perineum and difficulty in defecating is experienced.

If, on the other hand, the tubercular foci lie close to the urethra, the symptoms are those of posterior urethritis, viz.: frequent and urgent urination, accompanied by a mucopurulent discharge from the urethra and shreds in the urine.

There is no distinct pain after the act of micturition, but a feeling as though the bladder were not fully emptied.

Defecation spermatorrhea sometimes occurs if the deeper-lying prostatic tubules are infiltrated with nodules. Another form of secretion from the meatus is occasioned by the breaking down and discharge of small abscesses through the urethra.

Hematuria is a frequent symptom, and is not constant, but intermittent. The blood comes at the end of urination, and is not due to an ulceration of the urethra, as formerly supposed, but merely to the congestion of the prostate.

In uncomplicated cases *pain* may be excruciating, and is sometimes so severe that it overshadows all the other symptoms.

As the disease progresses, the bladder is always affected. This is announced by the occurrence of pain after urination and tenesmus, and as the cystitis grows worse the bladder symptoms become the marked feature in the case.

In most cases of tuberculous prostatitis death is caused by an ascending infection, involving first the bladder and subsequently the kidneys, or the lungs may be attacked, or a general miliary tuberculosis may be established.

In a few rare instances the disease remains limited to the prostate; an abscess forms, which breaks and discharges, the cavity cicatrizes, and a cure follows.

DIAGNOSIS.

On rectal examination the tubercular prostate will be found enlarged in one or both lobes. The enlargement is distinctly nodular or lumpy, and at first of a stony hardness. After the abscess forms, points of softening with fluctuation can be readily felt.

It is often extremely difficult, indeed sometimes impossible, to determine whether the enlargement is in the prostate or involves the seminal vesicles, for these different organs may be so blended together

by the inflammatory exudation that the lines of demarcation cannot be defined. On this account it was formerly supposed that every tubercular process in this region was confined to the prostate, whereas we now know it to be true that the tubercular process may attack prostate and vesicles together, or either organ be involved alone.

The gonorrheal inflammations of the prostate, chronic prostatitis, or the acute suppurative form resembles in physical signs the tuberculous disease, and it is impossible definitely to establish the diagnosis of tuberculosis until the presence of tubercle bacilli has been demonstrated in the secretions. These may be collected by expressing, with the finger in the rectum, the secretions from the prostate gland, and the bacilli are also generally present in the discharge from the meatus which so often exists.

If no tubercle bacilli are found in examining the secretions, guinea-pigs may be inoculated with the discharges, and, if the pig develops tuberculosis, the diagnosis is, of course, established.

In cases of general tuberculosis it is usually safe to consider every enlargement of the prostate tubercular in character, and the only difficulty in diagnosis arises in the cases where the prostate is the seat of primary tuberculosis.

PROGNOSIS.

The prognosis is, of course, of the gravest, although when the tuberculosis is limited to the prostate alone spontaneous cure sometimes occurs through healing of the cavity after the abscess has formed and burst.

Unfavorable elements in the case are an hereditary predisposition to tuberculosis and a tendency for the disease to extend and involve other organs.

TREATMENT.

The general treatment consists in endeavoring to vitalize the tissues by means of a life in the open air or a prolonged sea-voyage, abundance of nourishing food, and the administration of codliver oil, creosote, guaiacol, and other antitubercular remedies.

There is a difference of opinion as to the advisability of beginning local treatment early. In general, it is better to avoid instrumentation, for the reason that the local resistance of the tissues is reduced, and infection of the bladder with other micro-organisms readily occurs.

On the other hand, instillations into the posterior urethra in the early stages have their advocates. Guyon advises corrosive sublimate solution, 1 : 5000 to 1 : 3000, and iodoform in glycerin is warmly recom-

mended by Berkeley Hill. Everyone is agreed that nitrate of silver uniformly acts badly, and its use is contraindicated.

After cystitis has set in, the principal indications are to control the pain and tenesmus, but these matters have been considered in another section. (See Cystitis.)

Under the head of **operative treatment** may be considered, first, the suggestion of Hoffmann, which was to inject 10 per cent. emulsion of iodoform and glycerin into the substance of the prostate by means of a long needle thrust in through the perineum. This procedure has never gained favor, and is today practically abandoned.

A few years ago, when the *dictum of* Sir Henry Thompson, that "tuberculosis of the prostate was never primary, but always secondary to deposits elsewhere," was accepted as final, it was thought useless to attempt to extirpate the diseased prostate, and the rule was only to operate when pus had formed, in order to evacuate the contents of the abscess.

At the present time the opinion has changed, and the operation of laying bare the prostate by a semilunar incision, curving around the rectum and removing all the diseased tissue with a curette, commends itself as a rational and conservative procedure, and one which is likely to bring about a radical cure when the disease is limited to the prostate alone.

When the prostate is secondarily affected and deposits exist in the epididymis or kidney, as is nearly always the case, operative interference with the prostate is quite out of the question, but if the kidney or testicle be removed the secondary deposit in the prostate usually clears up and disappears.

The spontaneous healing of the local focus may be aided by the use of tuberculin injections.

DISEASES OF THE KIDNEYS.

CHAPTER XVI.

MOVABLE KIDNEY.

An unnatural movability of the kidney occurs in two forms:—

(*a*) **Movable kidney** is more frequent in its occurrence. In this variety the kidney moves about freely behind the peritoneum, as it lies in a sort of pouch or cavity formed within its own fatty capsule.

(*b*) **True floating kidney** lies closely surrounded by its fatty capsule, and is supplied with a mesonephron, which is attached by one end to the spinal column, but which is so long that it allows the kidney to float about freely in the peritoneal cavity. The extent of the excursions of the kidney depends only upon the length of its mesonephron.

ETIOLOGY.

Movable kidney occurs more frequently in females than in males, Lindner finding that 1 out of every 5 or 6 women examined was so affected, and the right kidney is more frequently movable than the left.

True floating kidney is either caused by a congenital mesonephron or it may exceptionally be the last stage of a movable kidney.

Various reasons are suggested for the preponderance of movable kidney in the female, the chief of which are laxity of the abdominal walls as a result of child-bearing. On closer scrutiny, the facts do not uphold this theory, for a movable kidney is found as often among virgins and nulliparæ as among women who have borne children.

It is probable, however, that the cause of movable kidney in both sexes is the absorption of the fat which surrounds the kidney and acts as a cushion and support to it, as a consequence of the emaciation occurring in wasting diseases.

If the fat is absorbed, a slight blow or muscular strain, such as the exertion of vomiting, may be enough to loosen the kidney from its attachment and permit it to move about more or less freely.

SYMPTOMS.

The symptoms of movable kidney are, of course, obscure. Gastro-intestinal symptoms, such as flatulence and dyspepsia, are generally

present, and have been accounted for by the supposition that the kidney in its abnormal situation exerts pressure upon the duodenum and narrows its lumen, thus causing partial retention and fermentation of its contents.

Edebohls considers these symptoms due to pressure and traction upon or stretching and irritation of fibers of the solar plexus, lying in the abdomen and belonging to the sympathetic nervous system, because it would seem that the theory of obliteration of the lumen of the duodenum is insufficient to account for the symptoms.

Edebohls calls attention to the other symptoms which are generally caused by floating kidney, as follows: Pain is felt in the epigastrium, which is not increased by pressure, and is located somewhere to the left of the median line at or near the free border of the left costal cartilages. General nervousness in greater or less degree exists, and is usually accompanied by cardiac palpitation and habitually rapid action of the heart.

These patients are also unable to sleep or to rest comfortably while lying upon the left side.

In true floating kidney with a long mesonephron, in addition to the presence of the above-mentioned disturbances, the patient is conscious of abdominal pains, of a dragging or pulling character, and the sensation is felt as if some foreign body were moving about in the abdominal cavity, particularly after a sudden muscular exertion, or upon rising up suddenly after lying down.

The pain may be only wearing in character, or it may occur in paroxysms and be agonizing. Its onset is sudden, and it is apt to follow fatigue or active exertion. The pain in some cases is due to attacks of local peritonitis.

Nervous disturbances, hypochondria, melancholia, and hysteria usually occur, either as reflexes or from disturbances of nutrition. The secretion of urine by the misplaced kidney is, in general, not interfered with.

DIAGNOSIS.

The diagnosis is not difficult to make in thin subjects with relaxed abdominal walls. By palpating the flank between the fixed border of the ribs and the crest of the ilium the displaced kidney can be felt between the two hands.

In fat subjects the diagnosis presents greater difficulties. If the kidney has been displaced into the pelvis, it may be mistaken for an ovarian or fibroid tumor; but the kidney may be differentiated by replacing it with ease in its natural position in the flank, while the attachment of its mesonephron prevents its complete descent into the pelvis.

If the mesonephron is shorter and the kidney is found lying in the abdomen, it might be looked upon as a distended gall-bladder, enlargement of the spleen, or a tumor of the omentum.

PROGNOSIS.

A kidney which once becomes movable never again becomes firmly fastened in place, except by operative interference.

A misplaced kidney, however, is, in general, not fatal to life, and, if death occurs, it is usually the result of exhaustion from chronic dyspepsia, continued pain, and nervous depression, although death is sometimes due to malignant disease developing in the displaced organ.

TREATMENT.

The symptoms of movable kidney may be ameliorated by lying in bed, by the Weir Mitchell treatment, and by massage and electricity; but none of these methods offers much prospect of permanent relief (Edebohls).

A simple bandage of elastic webbing without any pad over the kidney, and which, encircling the whole abdomen, makes as much pressure as the patient can comfortably bear, helps to support all the abdominal viscera and with them the kidney. Such a method may be tried before proceeding to operation, but it is generally found to be ineffective in holding the kidney in place.

On account of the difficulty of retaining the kidney in position, nephrorrhaphy, or fixation of the kidney, is advised by Edebohls as the first resort in patients with movable kidneys which produce decided symptoms.

Nephrorrhaphy is an operation which is not attended with much danger to life, and it is generally successful in fixing the kidney and relieving the symptoms. Delvoie reports 215 cases operated on by fixation, of which 135 were cured, 30 improved, 25 unimproved, 20 relapsed, and 5 died.

Nephrectomy, or total removal of the kidney, has no justification when the kidney has only a small range of motion, and the operation is accompanied by a very high mortality.

In cases of true floating kidney with a long mesonephron, it may be impossible to fix the kidney in place. Such a contingency would demand nephrectomy by the lumbar incision if possible, and, if this is not practicable, by means of a laparotomy, although the mortality is much higher with the abdominal route than when the kidney is removed through the flank and without opening the peritoneal cavity.

Pyelonephritis; upper pole of kidney, seat of large abscess cavity. Ascending infection from gangrenous cystitis behind impassable stricture and perineal fistulæ. Suprapubic cystotomy for drainage. Death four days later from suppression of urine. (Author's case.)

PYELITIS.

In suppurative pyelitis, often called *surgical kidney,* the pelvis of one kidney may be attacked alone, or both kidneys may be affected.

The **pathological change,** if due to an ascending infection, begins in the pelvis of the kidney, which becomes distended with pus, and if the ureter is blocked, so that the pus cannot be discharged into the bladder, in course of time the interstitial secreting substance of the kidney is utterly destroyed, and the organ is converted into a mere shell surrounded by its capsule and filled with pus. This condition is called **pyonephrosis.**

In **pyelonephritis** the suppurative process involves not only the pelvis, but the secreting structures of the kidney as well.

A number of small abscesses form between the tubules, and as they increase in size the intervening portions of tissue break down, so that several of the abscesses become merged into one.

The secreting parts of the kidney involved in the process are destroyed, and the secretory function of the kidney is, of course, impaired.

When the organisms are carried through the blood and hematogenous infection takes place, they are deposited in the parenchyma of the kidney, causing primarily a pyelonephritis, but when the infection ascends from the bladder, through the ureters, the pelvis of the kidney is first attacked and the parenchyma becomes involved later.

After destruction of the kidney-substance the fluid portion of the pus is often absorbed, and upon autopsy the kidney is found to be made up of several sacculi containing grayish, putty-like masses, which are often mixed with calcareous material.

ETIOLOGY.

Suppuration of the kidney is always caused by micro-organisms, of which the most frequent forms are the *Staphylococcus aureus* and the colon bacillus, and, in tubercular pyelitis, the tubercle bacillus.

The modes of infection may be (*a*) *ascending,* caused by the passage of micro-organisms from the bladder upward through the ureters, and (*b*) *hematogenous,* in which case infective emboli occurring in sepsis, tuberculosis, or the infectious fevers are conveyed to the kidney through the blood-current.

Predisposing Causes.—The most important and frequent cause of pyelitis is inveterate cystitis from the retention of urine in the bladder behind a stricture or enlarged prostate.

The urine is dammed back upon the kidneys, causing a distention of the pelvis, and infection with micro-organisms, which are conveyed through the ureters from the bladder, readily takes place.

Renal calculi in themselves do not excite pyelitis, but the prolonged mechanical irritation to the kidney, which their presence causes, lowers its resisting power and permits the entry of germs.

Infectious diseases—such as typhoid fever, pneumonia, scarlatina, small-pox, and general tuberculosis—lead to the formation of infectious emboli, which are carried through the general blood-circulation and are often deposited in the kidney.

SYMPTOMS AND COURSE.

Pyelitis may be acute or chronic, and, as most cases are secondary to some other condition, the symptoms are often obscured by those of the primary disease.

The **acute form** begins with a chill and high fever, accompanied by dry tongue, thirst, and great prostration. The urine contains pus, bacteria, and albumin, depending on the extent of the kidney involvement. Sometimes death follows quickly, but often the temperature subsides, either suddenly or gradually, or the fever may become remittent in type, until the temperature finally becomes normal and the acute attack merges into the chronic form.

In the acute form the kidney region is seldom tender. Tenderness on palpation, as a persistent and prominent symptom, is usually a sign that abscess of the kidney is beginning or has already formed.

The transition from the acute to the chronic form is not infrequent, but **chronic pyelitis** generally begins insidiously, and both pyelitis and pyelonephritis may run their course without fever.

The ascending form of pyelitis is always accompanied by disease of the lower urinary tract, and may result from acute gonorrhea or cystitis, with obstruction to the urinary outflow, from stricture, hypertrophied prostate, paralysis of the bladder, vesical calculus, or tumor.

Pyelitis may remain without change for many years, and the pus formation may continue in the pelvis of the kidney for a long time, without its parenchyma being attacked. More frequently it happens that a nephritis becomes engrafted upon a pyelitis; but even a pyelonephritis often runs such a chronic course and the destruction of the kidney tissue is so gradual that years may pass before the patient observes any disturbance.

This is, however, the exception, for usually, after some length of time, marked symptoms arise: the patient emaciates slowly; his tongue is coated; the nutrition is impaired; he is distressed with dyspepsia and vomiting, and he presents the aspect of a person suffering from some grave disorder.

This condition arises in the course of a unilateral pyelitis, as well as when both kidneys are affected, and is due not so much to a kidney insufficiency as to a poisoning of the blood, or toxemia. It comes much earlier in the progress of the case when frequent feverish attacks occur.

It is by no means infrequent that the pyelitis remains latent without causing any symptoms, until the operation of litholapaxy, internal urethrotomy, or the commencement of catheter-life causes it to become active.

In these cases the symptoms which arise are partly due to want of elimination, on account of the destruction of the secreting portion of the kidney, and partially from urinary fever, caused by the absorption of the micro-organisms and toxins into the circulation from a wound in the genitourinary tract.

The symptoms consist in a diminution in quantity or complete suppression of the urine. The urine contains blood, often in abundance. The temperature rises, and is accompanied by feeble pulse and great prostration. Delirium and coma set in, and are followed by death.

Tenderness over the kidney region as a symptom of pyelitis is very unreliable; occasionally it is present and of some value, but its absence does not signify that the kidney is healthy. The patient often complains of an annoying feeling of weight in the kidney region, which is particularly noticeable on active movements.

A distinct tumor may be present or absent, for pyelitis may exist without any dilatation of the pelvis. On the other hand, there may be an accumulation of pus which will cause an appreciable swelling, or a pyelonephritis of long standing may cause a contraction of the kidney.

It frequently happens that, with a considerable amount of pus formation, the ureter becomes occluded and the pus is forced back upon the pelvis of the kidney, which consequently becomes larger and more tender.

During the time of obstruction the urine becomes free from pus and quite clear, and the retention is accompanied by fever and typical kidney colic.

From the vague and unreliable character of the symptoms we are obliged to depend for diagnosis on the *changes in the urine*.

It has been believed that the urine of pyelitis presents certain characteristic alterations.

The quantity, reaction, presence of albumin, and form of the epithelium have been supposed to be pathognomonic, but at present we

can only say that the one permanent and always-present characteristic of pyelitic urine is that it contains pus.

While it is true that the urine of pyelitis and pyelonephritis is generally acid, it is also the case that many patients with cystitis have acid urine, and, again, if the urine in the pelvis of the kidney is alkaline, pyelitis will also show an alkaline urine.

The quantity of urine secreted is increased, and is often from two to three times the normal amount.

Blood is frequently present, and is increased by activity on the part of the patient. It may be uniformly disseminated through the urine or appear as long clots formed in the ureters.

Microscopic examination of the sediment shows pus, albumin, small quantities of epithelial cells from the pelvis of the kidney, considerable mucin, and numberless micro-organisms.

If pyelitis is dependent upon a renal calculus, in addition to the pus-cells fragments of the calculus may be present, and crystals of uric acid, urates, or triple phosphates are always found. The quantity of desquamated epithelium is greater, and some blood is present.

Persistent absence of casts is in favor of pyelitis, as, in contracted kidney, casts may disappear for a time, but only temporarily.

Epithelium cells which are club-shaped, or composed of many layers attached together in sheets, were formerly supposed to originate in the pelvis of the kidney, but it is now known that these forms also occur in the deeper layers of the lower urinary passages, and consequently they cannot be regarded as distinguishing characteristics.

In uncomplicated pyelitis, albumin is but slight in quantity, and the small quantity present is accounted for by the pus in the urine. Even when large quantities of pus are formed, the albumin may not amount to more than 0.01 per cent.

In pyelonephritis the albumin is greater and out of proportion to the pus, and is relative in amount to the involvement of the kidney.

It is, however, impossible to differentiate a cystitis from a pyelitis by the amount of albumin.

There remains, then, the *single symptom of pus in the urine;* but as other diseases of the bladder, prostate, and urethra also show pus in the urine, in order to make the diagnosis of pyelitis it is necessary to determine if the pus comes from the kidney or not, and furthermore to decide if one kidney alone is diseased, or if both are affected.

The question as to whether cystitis or a pyelitis is present can generally be decided by observing the course of the case, as every case of cystitis, except those caused by malignant tumors, tuberculosis, or

calculus, improves under local treatment of the bladder, and the improvement is demonstrated by the urine becoming clearer.

If no diminution of the quantity of the pus in the urine takes place, it may be accepted as a fact that the pus comes from the kidney or its pelvis.

A maneuver which is sometimes of use in differentiating between cystitis and pyelitis consists in washing out the bladder thoroughly and then waiting for fifteen minutes; the urine which has accumulated in the bladder during that time is then drawn off with a catheter.

If the kidneys are healthy, but cystitis is present, a *small* amount of pus will appear in the urine when it is drawn off, but if the bladder is healthy and pyelitis exists the urine will contain a comparatively *large* quantity of pus.

The question, however, as to whether the pus comes from the bladder or kidney, as well as which side is attacked, can only be settled by **a cystoscopic examination with catheterization of the ureters.**

The ureter openings are viewed with the cystoscope, and a jet of turbid urine is often seen issuing from one or both mouths.

If the turbidity of the urine issuing from the ureter mouth is but slight, so that the observer is in doubt, the ureter catheter is introduced into both ureteral openings and the separate urines are drawn from each kidney.

If pyelitis is absent, the urine drawn from the kidney contains only epithelium and perhaps a few red cells (diapedesis through hyperemia).

If pyelitis exists, *pus-cells* are present in the urine.

To decide if the parenchyma of the kidney itself is affected, or only its pelvis, the urine drawn with the catheter must be tested as described in the section on estimation of the renal function.

PROGNOSIS.

The prognosis of chronic pyelitis depends upon several factors.

A simple pyelitis can remain limited to the pelvis of the kidney without change for many years, and without involving the parenchyma of the organ, and the patient remains free from any particular discomfort.

In course of time, however, the parenchyma of the kidney is apt to be attacked and a condition of pyelonephritis is established, which leads to the gradual destruction of the kidney and offers a grave prognosis.

This is particularly true of cases of pyelitis in old men, caused by ascending infection from cystitis due to stricture, calculus, or enlarged prostate.

Such cases generally terminate fatally in the course of a few years, from pyelonephritis with toxic absorption.

The fatal end is often precipitated by any operative interference upon the lower urinary tract, and the presence or absence of pyelitis is usually the most important element in the prognosis in cases of vesical calculus, stricture, and enlarged prostate.

Unilateral disease of the kidney offers, of course, a better prognosis than when both kidneys are affected.

The treatment of acute pyelitis consists in the application of antiphlogistic remedies, local bloodletting, application of ice to the lumbar region, narcotics for pain, antipyretics for the temperature, urotropin for disinfecting the pelvis of the kidney, and the patient should be put upon a bland diet, with regulation of the bowels and copious draughts of spring water.

Under this treatment, in most cases, the active symptoms subside and the process becomes chronic.

In the presence of threatening symptoms, such as high fever and chills, after the exact diagnosis as to which side is affected has been made, an incision into the kidney (nephrotomy), with evacuation of the pus, sometimes has a brilliant curative effect upon both pyelitis and pyelonephritis.

The treatment of chronic pyelitis is conducted on the same lines as the acute form, urotropin, abundance of spring water, rest, baths, and diet being the principal measures, although the chances are small that the lesions will heal.

In *gonorrhœal pyelitis* or when caused by the colon bacillus, Casper and others have obtained excellent results from catheterizing the ureters and washing out the pelvis of the kidney with a nitrate-of-silver solution.

Casper reports 12 cases (9 gonococci and 3 *Bacillus coli*) where all other means had failed, and which were entirely cured by this procedure. Irrigation of the pelvis of the kidney is contraindicated in the presence of pyelonephritis, tuberculosis, or renal calculus.

Technique.—The ureter is catheterized in the usual way, and about ½ ounce of nitrate-of-silver solution, beginning with 1 : 1000 in strength, is injected through the catheter into the pelvis of the kidney. The catheter is withdrawn, and the solution gradually flows out through the ureter.

At the present time very strong hopes of a cure cannot be held out, but this means of treatment may be tried before proceeding to operation.

OPERATIVE TREATMENT.

The operation indicated depends upon the extent of the destructive process in the kidney and whether one or both kidneys are affected, and

also if the process is tuberculous or due to an ascending infection or originating from a renal calculus.

I. One Kidney Alone Diseased.—(*a*) In the case of an abscess of the kidney from a punctured wound or a renal calculus, it is desirable to drain as early as possible, in order to prevent destruction of the kidney-structures.

In unilateral pyelitis which is not too far advanced and not tuberculous in origin, good results are obtained by the operation of **nephrotomy.**

The kidney is exposed, an incision made into its pelvis, and the cavity explored for a stone and subsequently drained by a drainage-tube. If the kidney is found riddled with small abscesses, it is advisable to do **nephrectomy** and remove it at once.

It was formerly believed to be safer to allow a few days to elapse after cutting down upon the kidney, before removing it, but further experience shows that it is better for the patient, to take out the kidney at the first operation, if nephrectomy is indicated.

II. Both Kidneys Diseased.—In such conditions nephrectomy is out of the question, and in feeble old men who are suffering from stricture or enlarged prostate no operation can be undertaken which holds out much prospect of recovery.

If the patient with a double-sided pyelitis is in better general condition it has been suggested doing a *nephrotomy* on one side, and, after draining the kidney for a time, doing a nephrotomy on the second kidney.

Evacuation of the pus through an incision may relieve the septic condition, and, if the kidneys are not too much disorganized, they may be able to carry on their eliminative function sufficiently to maintain life.

The questions as to the ultimate cure and the amount of danger following this procedure are still under discussion.

HYDRONEPHROSIS.

When, from some mechanical obstacle in the ureter, the urine is prevented from flowing out from the pelvis of the kidney, retention of the non-purulent urine occurs, and the pelvis and calices of the kidney become enormously dilated. Atrophy of its secreting substance takes place, with the formation of distinct cysts, which may attain to a very great size.

ETIOLOGY.

Congenital Causes.—The ureter may be entirely absent, or obliterated in some part, or the obstruction may develop after birth, on

account of a twisting of the ureter or the formation of a valve-like fold, causing partial or complete closure of its lumen.

If an abnormal insertion of the ureter exists either at its origin from the pelvis of the kidney or at its entrance into the bladder, the angle of the insertion of the ureter may be so acute that it is compressed and its lumen closed when the patient is in the standing position.

Acquired Causes operate either by compressing the ureter or obstructing the outflow of urine and causing it to be dammed back upon

Fig. 209.—Hydronephrotic kidney without much enlargement.

the kidneys. Tumors of the ovary and ureters, prostatic hypertrophy, and atony of the bladder will produce this effect at times.

A very frequent cause of hydronephrosis is a renal calculus acting as a ball-valve as it lies in the pelvis of the kidney at the mouth of the ureter, or if it enters the ureter and becomes fixed at any point in its course.

From any of these causes the obstruction may be *complete*, so that no urine can pass through the ureter, or it may be *incomplete*, and a portion of the urine passes through into the bladder.

Intermittent hydronephrosis occurs chiefly as a result of a movable kidney, as changes in the position of the kidney cause bends and twists in the ureter, and in consequence stagnation of the urine in the pelvis of the kidney, and ultimately dilatation with cystic formation.

The sac becomes completely filled, and then, if the obstruction is temporarily removed, it is emptied, and a large discharge of urine occurs into the bladder, and the hydronephrotic tumor disappears.

The obstruction in the ureter returns and the sac gradually refills, and after a varying time is again emptied.

The process of accumulation and discharge is repeated indefinitely unless the ureter becomes completely and permanently blocked, which usually occurs in the course of time.

SYMPTOMS.

The symptoms of hydronephrosis are vague and indefinite, and consist in the formation of a fluctuating tumor in the flank, which may be large enough to fill the entire abdominal cavity, together with frequent urination, and a diminution in the quantity of urine passed. The symptoms caused by *intermittent hydronephrosis* are generally occasioned by a movable kidney, in which condition the ureter is obstructed by being bent at an angle.

The attacks are accompanied by violent pain and diminution in the quantity of urine, and may easily be mistaken for an attack of renal calculus. When the kidney falls back into its normal place the ureter is straightened out, the pain ceases suddenly, and large quantities of urine are discharged.

PROGNOSIS.

Hydronephrosis may remain stationary for years, but the pressure of the accumulated fluid leads, in time, to an atrophy of more or less of the parenchyma of the kidney-substance, although the secreting structures are never entirely destroyed.

The affection is often complicated by infection with pyogenic organisms, and the case becomes converted into one of pyonephrosis, with its attendant dangers.

Large sacs have been known to rupture into the abdominal cavity and cause peritonitis, and in a few cases of intermittent hydronephrosis spontaneous cure has occurred.

DIAGNOSIS.

The diagnosis presents many difficulties, although a history of the sudden disappearance of a tumor coincident with the discharge of large quantities of urine is eminently suggestive of intermittent hydronephrosis.

An ovarian tumor is very liable to be mistaken for hydronephrosis. The distinguishing point is the situation of the kidney tumor in the flank, with the colon or small intestine in front of it.

Exploratory puncture of the tumor may throw some light upon the case, by furnishing a fluid containing urea or uric acid, but those ingredients of urine often disappear by absorption, and the liquid resembles that contained in any simple cyst. Catheterization of the ureters settles the question of diagnosis, by demonstrating if urine issues from one or both ureters and if it is clear or purulent. If catheterization is difficult, chromocystoscopy with indigo-carmin will give the same information.

TREATMENT.

It is seldom possible to remove the obstruction in the ureter and re-establish the flow of urine through it, except when due to movable kidney or pressure upon the ureter from an abdominal growth, and the various attempts to do away with the obstruction by massage and ureteral catheterization, etc., have been rarely crowned with success.

In **double hydronephrosis incision** of both saccular kidneys by lumbar nephrotomy, with an interval between the two operations, and the establishment of a permanent fistula, although causing great inconvenience to the patient, afford the only hope of arresting the destruction of the secreting portions of the kidney and saving the life of the patient.

In **unilateral hydronephrosis** incision and drainage through the loin (nephrotomy) is the operation of choice, and later on, if the annoyance of the fistula becomes unbearable and the other kidney is found to be healthy, nephrectomy may be done upon the diseased kidney and the fistula allowed to close.

Before nephrectomy is undertaken it may be desirable to endeavor to remove the obstruction in the ureter by catheterization, or the advisability of transplantation of the ureters may be considered.

The operation of aspiration, or **lumbar puncture**, although formerly practised, is seldom employed today, except in the cases where an operation is strongly indicated, but for some reason nephrotomy cannot be performed at the time.

In certain cases of intermittent hydronephrosis a permanent cure is said to have followed the operation of lumbar puncture.

When hydronephrosis depends upon a movable or floating kidney nephrorrhaphy is indicated, and when the kidney is fixed in place the accumulation of urine and overdistention of the pelvis of the kidney may cease.

PYONEPHROSIS.

Pyonephrosis is always secondary to some other condition, and it may develop in two ways: (*a*) as a result of infection with micro-organisms of the watery contents of the kidney in *hydronephrosis*, or (*b*) in conse-

quence of the occlusion of the ureter in a case of *pyelonephritis*. In either instance the pelvis of the kidney becomes rapidly distended, and the kidney itself is soon destroyed by the formation of multiple abscesses in its parenchyma. The entire kidney becomes converted into a large sac surrounded by its capsule and filled with urine and pus.

In course of time the tumor becomes firmly attached to the abdominal wall by adhesions, and suppuration occurs outside the kidney, forming paranephritic abscess.

The ureters become thickened in their walls, and often converted into an impervious string of tissue, or, on the other hand, the ureters may be dilated.

SYMPTOMS.

On account of the different ways in which pyonephrosis begins, the clinical picture is a varying one.

One symptom which is always present as long as the ureter remains patulous is *pus in the urine*. This, as a rule, is constant, and not remittent, unless the ureter becomes occluded, when constitutional symptoms occur. Under such circumstances colicky pain in the lumbar region is felt, the pus disappears from the urine, and the quantity of urine is diminished; septic fever, with chills and well-marked remissions, also occurs. If the ureter becomes patulous again, pus reappears in the urine and the temperature falls to normal.

Disappearance of pus from the urine, however, does not invariably imply that the ureter is occluded. For it sometimes happens that the abscess cavity in the kidney empties itself entirely of pus, and the urine remains clear for several days, until the pus reaccumulates in the kidney and again begins to flow out through the ureter.

In cases of pyonephrosis a *tumor* is present, and is felt as a rounded, tender, obscurely fluctuating mass located under the free border of the ribs. The tumor can usually be felt, unless it is high up under the ribs and the pus has been temporarily drained out through the ureter.

Pain is a somewhat inconstant symptom; often it is not present, or may only be elicited by deep pressure.

The general health of the individual always suffers in consequence of the drain of the suppuration and the attacks of septic fever, and the patient becomes emaciated and anemic.

DIAGNOSIS.

The first point to determine is, whether one kidney alone is affected, or whether both are diseased.

Sometimes a cystoscopic examination of the bladder shows a stream of purulent urine coming from one or both ureters.

If this is not adequate to establish the diagnosis, the ureter on the suspected side may be catheterized and the urine drawn from the bladder with a catheter for examination for comparison, or both ureters may be catheterized and the right and left urines examined.

In this way we can ascertain if the second kidney is healthy and how it is working. To decide the question as to whether it is at all diseased or if badly crippled, a chemical and microscopic examination of the separate urines is necessary.

PROGNOSIS.

The prognosis depends on how rapidly the suppuration advances, and, furthermore, if one kidney is affected, or both.

Unilateral pyonephrosis offers a better prognosis, and can exist for years without a bad effect upon the general health. In course of time, however, the long-continued absorption of toxins into the blood sets up a toxic nephritis upon the other side.

In exceptional instances spontaneous healing may occur, for the entire kidney may suppurate and be destroyed, becoming converted into a mass of connective tissue. This outcome is so extremely rare that it cannot be hoped for.

More frequently, however, when the suppuration is allowed to advance without operative interference, the surrounding connective tissue is attacked and a diffuse perinephritis and paranephritis is set up.

TREATMENT.

The treatment depends upon the character of the process and whether one or both kidneys are affected.

Internal treatment is of no use, since it is impossible to make the suppurating kidney-sac aseptic by drugs given by the mouth.

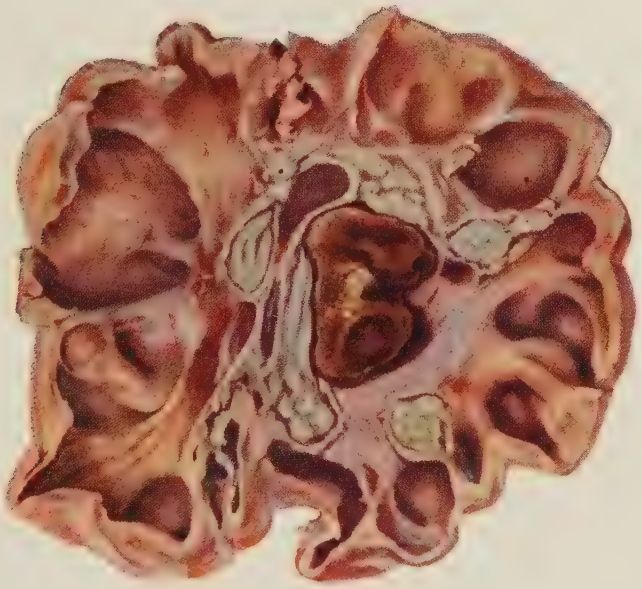
It is necessary to attack the foci of suppuration locally, either by irrigation of the pelvis of the kidney through a ureteral catheter or by means of incision or extirpation of the kidney.

Irrigation of the pelvis of the kidney is at present too new a method of treatment for us to decide its definite value.

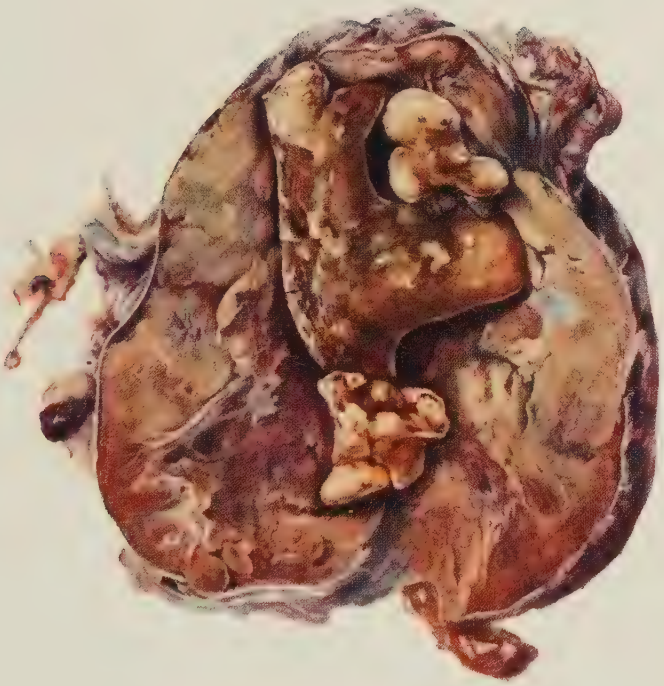
Casper states that it is very limited in its application, and is only useful in cases of infected hydronephrosis.

He reports 2 cases in which the pelvis of the kidney was converted into a great pus cavity, which were healed by irrigation of 1 : 1000 nitrate-of-silver solution.

In such cases as these it is proper to make the attempt to heal the pus cavities by irrigation through a ureteral catheter.



Renal calculus. Kidney parenchyma entirely destroyed and organ converted into a pyonephrotic sac. Nephrectomy. (Author's case.)



Renal calculus. Secreting parenchyma destroyed by formation of connective tissue. Nephrectomy. (Author's case.)

In a case of pyonephrosis, however, in which the kidney-substance is riddled with abscesses, which may not communicate with the pelvis of the kidney, the irrigation method is useless.

After the pelvis of the kidney has been successfully drained and washed out through the ureteral catheter a few times, and the patient's condition does not show a decided improvement, no further time should be lost, but operative measures should be proceeded with at once.

Nephrotomy is particularly applicable to the cases of infected hydronephrosis in which a good deal of healthy kidney-tissue is remaining; while by the typical multiple abscesses in the parenchyma of the kidney, *nephrectomy* is preferred on account of the danger of a fistula remaining behind. Before doing nephrectomy, however, the surgeon must know that the second kidney is competent to excrete the urinary secretion.

If the second kidney is badly diseased with its function impaired, nephrectomy is contraindicated, as it is a severe operation for an individual in broken-down health. Nephrotomy also fails to afford much benefit, as the patient is always annoyed with a troublesome fistula, which is continually leaking. For these reasons many surgeons are of the opinion that cases of double pyonephrosis are inoperable.

RENAL CALCULUS.

The formation of stone in the kidneys is of frequent occurrence, and often precedes vesical calculus. Stones composed of uric acid crystals are most common, and the next in point of frequency are oxalic stones. Phosphatic calculi are rare, and are caused by the alkaline decomposition of urine as a result of pyogenic infection.

The stones are generally found in the pelvis of the kidney, and may be single or may be in hundreds, or they may be imbedded in the parenchyma.

ETIOLOGY.

The causation of kidney-stone is generally the gouty diathesis (see Vesical Calculus). A few crystals are agglomerated in one of the renal tubules upon some substance, such as a blood-clot, coagulum of pus, or roughness of the wall, which serves as a nucleus. The agglomeration is washed out into the pelvis of the kidney, where it becomes the nucleus of a calculus.

The stone, if single, may be adherent to the walls of the pelvis of the kidney, or it may be movable and act as a ball-valve, closing the

mouth of the ureter. The urine is dammed back, in consequence causing *hydronephrosis.*

Infection with micro-organisms usually occurs, and suppurative nephritis follows.

SYMPTOMS.

A stone may be present in the kidney for years without causing much discomfort, as the symptoms are due not to the mere presence of a foreign body, but to obstruction. They are as follows:—

(*a*) Attacks of renal colic.
(*b*) Pain.
(*c*) Hematuria.
(*d*) Pyuria.
(*e*) Disturbances of the urinary function.
(*f*) Gastrointestinal disturbances.
(*g*) Passage of fragments of calculi.

Attacks of renal colic are strongly indicative of kidney-stone, although typical paroxysms may be induced by other causes, and not infrequently renal stone has been diagnosed and operated for and its absence demonstrated on cutting open the kidney.

Renal colic is caused by the stone being forced out of the pelvis of the kidney and entering the ureter. An attack comes on abruptly, and is characterized by agonizing pain, which is felt in the loin, and radiates down into the testicle and along the inner side of the thigh.

The pain may also radiate through the abdomen and chest, and be very intense in the back. In severe attacks nausea and vomiting occur, the pulse is feeble, the skin is covered with a cold sweat, and the patient is in a state of collapse.

In lighter cases urination is frequent and the urine discolored with blood, or the patient may be unable to empty his bladder.

In rare cases the secretion of urine may be entirely suppressed either from (*a*) reflex disturbance of the secreting kidney; (*b*) extensive disease of the other kidney, whose ureter is not blocked; (*c*) where only one kidney exists in the body.

In these cases uremic symptoms develop after a week, and death takes place within a fortnight after the obstruction.

The pain and disturbance of ureteral colic may last for a few minutes or for a number of hours, and usually cease abruptly as the stone either drops back into the pelvis of the kidney or makes its escape from the lower end of the ureter and enters the bladder.

The stone occasionally becomes permanently fixed in the ureter, in which case, after some time, the walls give way slightly around it,

permitting a portion of the urine to pass by; but the urine is dammed back upon the kidney, and *hydronephrosis* is developed.

Pain is felt over the affected kidney, which is increased by motion, jarring, and pressure over the side.

The sensation is that of a feeling of weight, rather than of acute pain, but the patient is liable to have paroxysms of acute pain, which often occur at night, when he is at rest in bed.

The pain radiates along the ureter and into the testicle, and often causes contraction of the cremaster muscle, with drawing up of the testicle on the affected side. The pain may be referred to the healthy kidney or to the bladder, thigh, or calf of the leg.

Fig. 210.—Renal calculus. Pyelotomy. Author's case.

Fig. 211.—Renal calculus. Nephrectomy. Author's case.

Hematuria occurs most frequently when the stone is passing through the ureter, but may appear when the stone is in the pelvis of the kidney.

The bleeding may come on in a slight amount, giving the urine a smoky color, or the urine may be free for days until, after some sudden exertion or a prolonged ride, a considerable amount of bleeding takes place.

Pyuria occurs only after suppurative disease of the kidney has occurred, but this is usually established in time.

Disturbances of Urinary Function.—The irritative effect of stone in the kidney causes it to secrete an excessive quantity of urine by day when the patient is moving about, but at night, when he is quiet in bed, the secretion of urine is normal in quantity.

As a result of blocking the ureter with a stone, the urine may be diminished in quantity or entirely suppressed for a time. If it per-

sists after the attack is past, it is clear either that the ureter of the functioning kidney is blocked with a stone and that the other kidney is so much diseased that it is not capable of secreting, or else that there is only one kidney present.

Occasionally the obstruction develops insidiously, without attracting attention until symptoms of uremia set in.

Gastrointestinal disturbances may be reflex in origin or may result from imperfect elimination by the diseased kidneys. Dyspepsia, vomiting, and epigastric tenderness may easily cause the condition of the kidneys to be overlooked.

Fig. 212.—Renal calculus. Nephrotomy with subsequent nephrectomy. Author's case.

Passage of fragments of calculi is very often absent, or the fragments are overlooked by the patient, but when present is of great value in indicating the presence of kidney-stone, even though colic was not caused by the passage of the fragments through the ureters.

DIAGNOSIS.

A positive diagnosis of renal calculus is difficult to make without the radiograph and ureteral catheterization, and many cases are on record in which the kidney was incised for the purpose of removing a stone when none was present.

The most characteristic symptoms of kidney-stone are passage of gravel or fragments of stone, attacks of typical renal colic, hematuria, and, in time, pyelitis.

Hematuria and pain are often caused by tubercular or malignant disease of the kidney, and oxaluria and strongly acid urine occasion a dull ache over the kidneys or even paroxysms of pain, which are sometimes accompanied by hematuria.

Spinal caries of the lower dorsal vertebræ and locomotor ataxia may simulate the pain of kidney-stone.

During an attack of renal colic it may be impossible to distinguish between the passage of a gall-stone or of a stone through the ureter.

Before attempting any operation it is, of course, essential to determine

Fig. 213.—Renal calculus removed by nephrolithotomy. Author's case.

if both kidneys are affected or if the disease is confined to one side only. The location of the pain and tenderness on palpation throws some light as to which side the disease is located upon, but the question may be settled positively by catheterization of the ureters and a radiograph.

The X-ray has been of great use since its introduction in diagnosing cases of kidney-stone, and is now regarded as one of the indispensable diagnostic aids.

Within the last year or so improvements have been made in the apparatus and technique of radiography by which it is possible to make skiagraphs of moderate-sized objects upon which a diagnosis can be made regardless of signs and symptoms, but in the preliminary examination it is not enough for the surgeon to depend upon the radiograph alone. He must also know the functional capacity of the other kidney, and this

can only be learned by ureteral catheterization and examination of the separate urines.

PROGNOSIS.

A stone may remain in the pelvis of the kidney for years without causing any serious disability, and only at times induce transient pain or

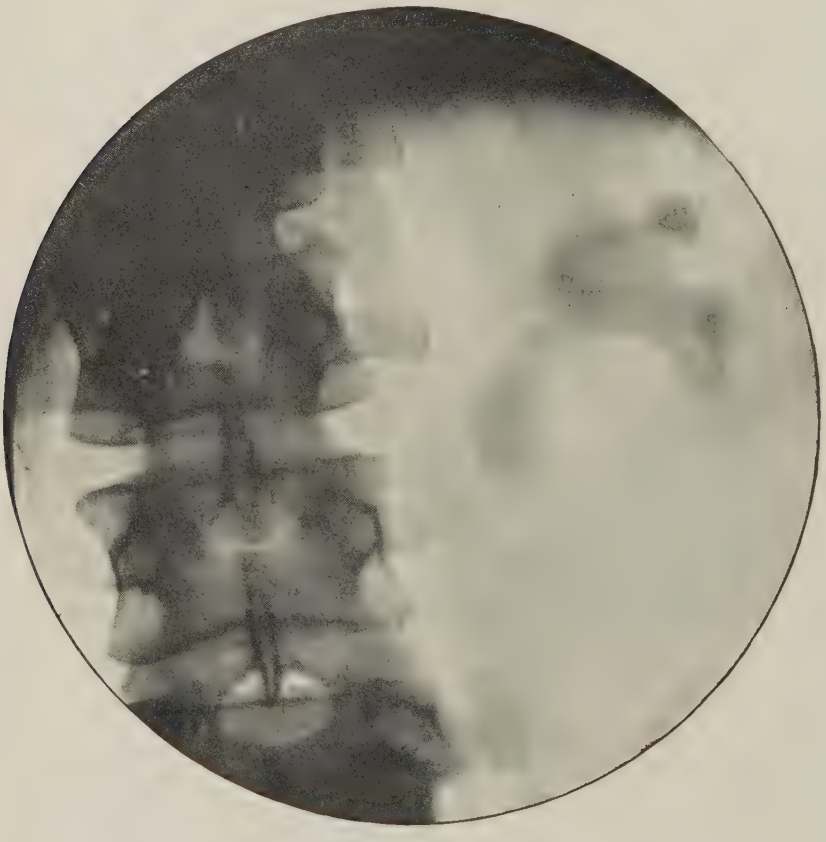


Fig. 214.—Radiograph of renal calculus. (Courtesy of *Dr. Eastmond.*)

hematuria, but the patient is continually exposed to the danger of obstruction of the ureter and suppuration of the kidneys from pyogenic infection.

If a fragment of stone passes into the ureter, it usually escapes into the bladder, but, if it becomes impacted in the ureter, disorganization of the kidney ultimately takes place, and the same is true if suppuration of the kidney occurs.

TREATMENT.

Attacks of renal colic are sometimes cut short by a prolonged hot bath and a full dose of morphine hypodermically.

In giving opium it is necessary to exercise caution and not give too large a quantity, for as soon as the stone is released and slips out of the

Fig. 215.—Radiograph. Kink in ureter from prolapse of kidney. (Courtesy of *Dr. Eastmond.*)

ureter the pain ceases, and the patient may be overcome by the effect of the drug.

In cases which do not respond to morphine it may be necessary to secure relaxation by means of anesthesia with chloroform or ether.

In the intervals of the attacks the general diathetic condition of the patient upon which the formation of stone depends should receive proper attention (see Treatment of Stone in the Bladder).

But little success has been attained by efforts at dissolving stones. Piperazin, in 5-grain doses taken in a pint of water three times a day, is thought to have some effect in dissolving the albuminous framework of a uric acid calculus, and phosphatic stones may perhaps be softened and broken down by urotropin.

It is said that a small stone may sometimes be assisted in passing through the ureter by administering glycerin, ℥iss by the mouth, three times a day.

The most important point in the treatment, in addition to regulation of the diet and general hygiene, is to keep the urine abundant and of low specific gravity by drinking freely of pure spring or distilled water.

Although a stone may remain for years in the pelvis of the kidney without danger to life, certain conditions—such as a deterioration of the general health, blocking of the ureter, or pyogenic infection of the kidney —call at once for the operation of *nephrolithotomy*.

This is indicated when the pain is persistent and severe, calling for the constant use of anodynes and accompanied by frequent attacks of renal colic and gradual emaciation and loss of strength.

Through a lumbar incision the kidney can be exposed and cut into, on its outer convex side, sufficiently to admit the finger into its pelvis, which can be thoroughly searched and the stone found and removed.

Small stones can be removed by making an incision into the ureter as it issues from the kidney, in this way sparing the more extensive damage to the secreting tubules.

If the kidney has been the seat of prolonged suppuration and has undergone a very considerable amount of destruction, it is better to remove the damaged kidney entirely, provided it has been previously ascertained that the kidney on the opposite side is sound.

DIAGNOSIS OF RENAL CALCULI BY THE X-RAYS.

The two following sections, together with the radiographs, were kindly furnished by Dr. Charles Eastmond, Roentgenologist to the Jewish and Kings County Hospitals:—

RADIOGRAPHY.

The use of the Roentgen method of examination in diseases of the urinary tract has become more and more exact, and is now one of the most important diagnostic aids. Such examinations, in order to be satisfactory, must be carried out by the expert, for one must be thoroughly familiar with the appearance not only of pathological conditions, but also of normal, though perhaps unusual, conditions which may simulate the pathological in appearance.

The details of technique need not be considered here, as they are not within the realm of the urologist.

The detection of calculi is the primary field. All calculi, regardless of their chemical composition, may be demonstrated in the kidneys and ureters. With vesical calculi, the Roentgen method is not so satisfactory as the cystoscope.

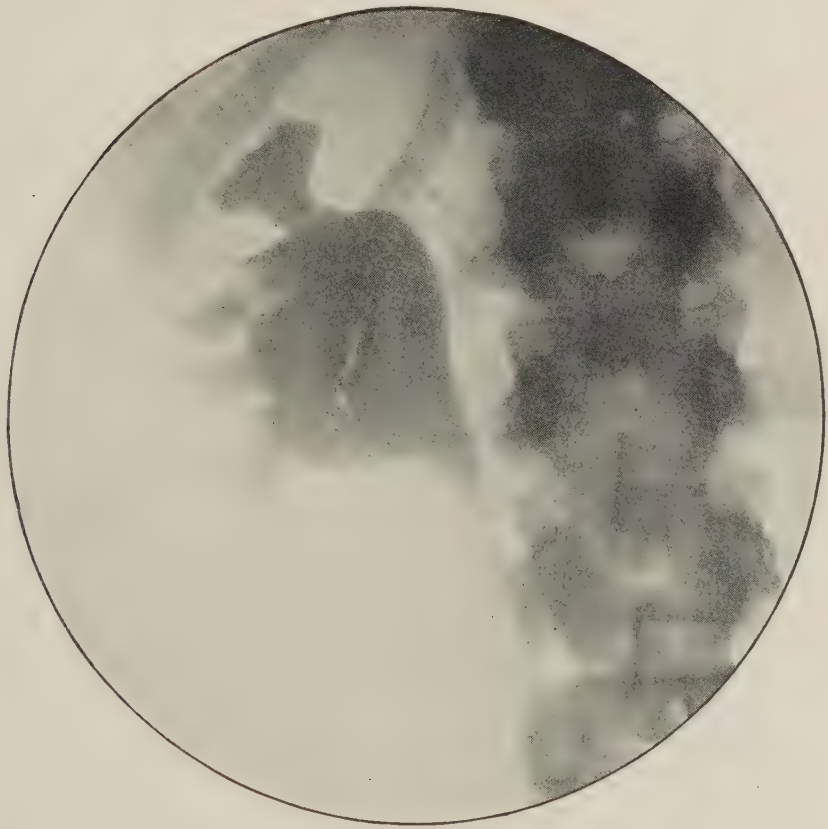


Fig. 216.—Radiograph showing hydronephrosis pyelography. Courtesy of *Dr. Eastmond.*

Gravel may not be apparent.

The size, shape, and position of the kidneys may often be shown, but it is not always possible to secure a complete outline of the organs.

PYELOGRAPHY.

This is a newer diagnostic method that has a very broad field of application. It is carried out by the cystoscopist in conjunction with the radiographer.

After the introduction of the cystoscope, with catheterization of the ureters, a silver salt is injected per catheter into the renal pelvis. Argyrol or collargol may be satisfactorily used in from 10 per cent. to 25 per cent. The injection is continued, very slowly, and with but slight pressure, until pain is experienced in the kidney region.

An X-ray plate is then taken of the part, and the cavity of the ureter and of the renal pelvis is clearly outlined by the silver. In this way any variation from the normal may readily be detected, and each pathological condition identified by its more or less characteristic appearance.

In hydronephrosis the enlarged pelvis and calices are sharp and distinct in outline, while in pyelitis, with or without distention, the margin is irregular and hazy.

Single or multiple cysts may be demonstrated if they connect with the renal pelvis.

Hydroureter with but incomplete obstruction is easily recognizable, as are kinks in the ureter from renal prolapse.

TUBERCULOSIS OF THE KIDNEY.

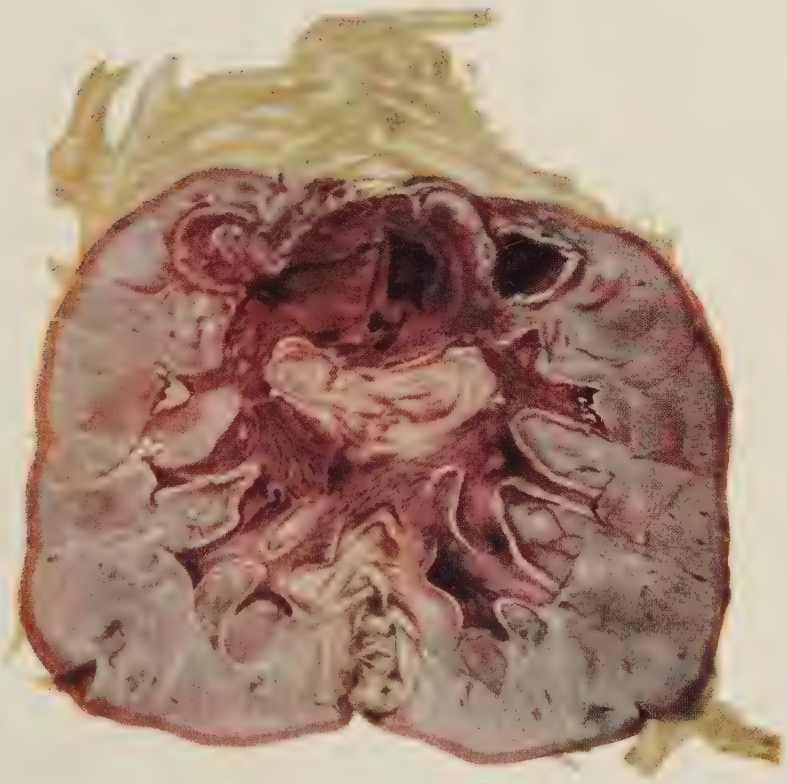
Renal tuberculosis was formerly supposed to originate invariably in the bladder and prostate, and to ascend through the ureters to the kidney; but it is now known that the tubercle bacilli are carried through the blood-circulation and deposited in the kidney, thus causing a *primary infection* of the organ.

The bladder is frequently affected secondarily, by the bacilli passing with the urine from the kidney, or it may remain entirely unaffected.

An ascending infection of the kidney from a tuberculous bladder is an occurrence of great rarity.

Tuberculosis of the kidneys is a disease of young persons, occurring almost always between the ages of 20 and 30. In point of frequency men and women are similarly affected. In the great majority of cases the tuberculosis is apparently a primary infection of one kidney, and it is not possible to demonstrate active foci of tuberculosis in the body, although they may exist latent and unsuspected. This is a most important clinical fact, for upon it is based the modern treatment of tuberculosis of the kidney, as an early nephrectomy removes the tangible focus of tuberculosis from the body. After the kidney is removed, further development of the infection does not occur, and the patient's life is saved.

The kidney may be infected in two ways, either from a focus of tuberculosis, from which the bacilli are carried through the blood in



Tuberculosis of kidney. A large abscess cavity at one pole and a good deal of parenchyma undestroyed and secreting. Nephrectomy. (Author's case.)

the form of emboli and deposited in the capillaries of the kidney, or the bacilli are taken into the blood through the stomach or lungs and are carried to the kidney, developing foci of tuberculosis at the point of weakened resistance. This is the so-called *hematogenous infection* and is by far the most common mode. One kidney alone is attacked at first, and after several months the other becomes infected. This is shown by post-mortem examinations, which demonstrate that after

Fig. 217.—Tuberculosis of kidney. Isolated foci in parenchyma which are beginning to break down. Author's case. Nephrectomy. Recovery.

long-standing tuberculous disease both kidneys are affected. The fact that in the early months only one kidney is infected is proven by catheterizing the ureters and examining the urine from the right and left sides. The necessity of early diagnosis is an important suggestion for treatment, for if the diseased kidney is promptly removed before infection of the other one nephrectomy prevents further trouble and is a life-saving operation.

This applies only to those cases of what might properly be called primary tuberculosis of the kidney in which foci cannot be demonstrated elsewhere in the body.

In a few cases the tuberculosis apparently begins in the prostate or epididymis and both kidneys are affected secondarily by an extension of the process, either by metastasis through the lymph-vessels and periureteral tissues, through the blood-current, or by a direct

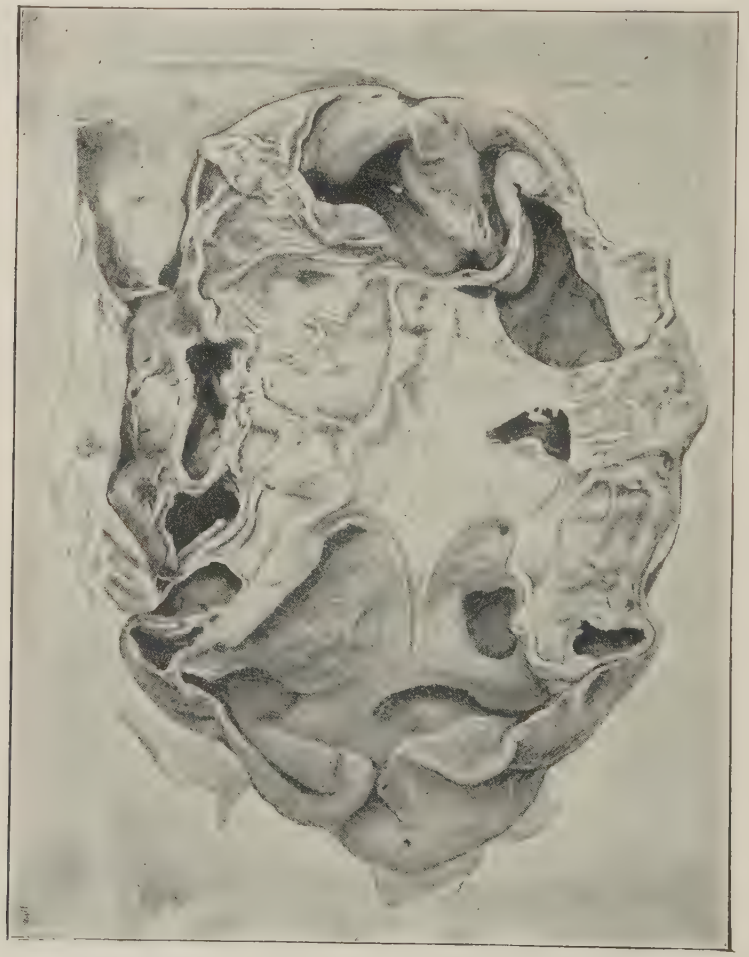


Fig. 218.—Tuberculosis of kidney. Isolated foci have broken down and formed cavities filled with pus, several of which communicate. Author's case. Nephrectomy. Recovery.

ascent of the bacilli through the ureters to the pelvis of the kidney. The extension of the process is slow, and the kidneys are only attacked shortly before the death of the patient, which occurs from ulcerative perforations of the bladder and urethra into the rectum.

It was formerly supposed that the kidneys were usually infected by a direct ascent of the tubercle bacilli from the bladder through the ureters, and, while this is the mode of infection in pyelitis, occasioned by stagnating urine in a bladder which cannot empty itself, as a result of stone, stricture, or enlarged prostate, it is known today that an ascending infection of the kidneys is a rare event in tuberculosis. An exception to this general rule takes place when the tuberculous process begins in the vas deferens or seminal vesicles. In these cases the process extends to the ureter, causing a stricture with stagnating urine. At night, with the patient in a recumbent position, the bacilli readily make their way through the ureter into the pelvis of the kidney and cause pyelitis.

PATHOLOGICAL ANATOMY.

The pathological anatomy of tuberculosis of the kidney consists in the deposit of isolated foci of tuberculosis in its parenchyma, which become cheesy, break down, and the pus is discharged into the pelvis of the kidney. After a time the foci coalesce and form large cavities, often communicating and filled with pus, or large abscesses may form at one pole and a good deal of the secreting parenchyma remains. Finally, if the patient lives long enough, the parenchyma is entirely destroyed and the kidney is converted into a mere shell, surrounded by a thickened capsule and containing cyst-like cavities filled with cheesy pus. The ureter sometimes becomes occluded and the pus has no exit, or the ureter remains patulous and the kidney becomes converted into a small, hard mass of fibrous connective tissue. Interstitial nephritis always ensues after a time and is caused either by the tubercle bacilli themselves or their toxins. Perinephritic abscess often follows as a complication and is formed by an ulceration from the tuberculous deposit extending through the parenchyma and perforating into the fatty capsule of the kidney. The pus is discharged through the sinus thus formed and retained within the fatty capsule. Where one kidney is the seat of a tuberculous deposit, the second kidney remains healthy for a time, but ultimately becomes infected through the blood. The fatty capsule of the diseased kidney becomes very much thickened and is converted into dense fibrous connective tissue, closely adherent to the kidney. This adds greatly to the difficulty of nephrectomy, so that subcapsular enucleation of the kidney may have to be performed in order to remove it. The ureters also become affected in a case of long-standing tuberculosis of the kidney. The process in the ureters may be a simple inflammation, in which case the walls become thickened and the canal may be converted into a solid string and agglutinated to the surrounding parts.

If the process is tuberculous, ulcerations and nodules form upon the ureteral mucous membrane.

The bladder nearly always becomes infected with the tubercle bacilli as they descend from the kidney in the urine. Small nodules form under the bladder mucous membrane, which coalesce, break down, and cause the typical ulcers of tuberculosis of the bladder.

THE SYMPTOMS

of tuberculous kidney are slight at first; a little impairment of the appetite is noted, with perhaps some feverishness at night. Later, loss of weight is noticeable, and there is an evening rise of temperature of 101° to 102°. If pyonephrosis or perinephritic abscesses develop, marked septic symptoms follow. If nephritis becomes marked, symptoms of uremia occur; and if the ureter becomes occluded, pains in the loin radiating along the course of the ureter resembling renal colic. The symptoms are not constant, but remissions, with repeated occurrences, are rather characteristic of the disease. In the early stages frequency of urination, particularly at night, is observed; but later, when the bladder has become involved with the formation of typical tuberculous ulcers, urination may occur every ten to fifteen minutes. The pain and tenesmus are intense; the urine is foul, containing quantities of pus and more or less blood. The urinary examination shows pus in the urine, unless the focus of tuberculosis does not communicate with the pelvis of the kidney, in which case there is none. When the abscesses break they discharge into the pelvis of the kidney, and pus again appears in the urine. In the early stages a moderate amount of pus is observed in the urine, which is remittent in character, but later large quantities are poured forth. Hematuria may occur, but not necessarily. A free hematuria usually denotes ulcerations at the apices of the pyramids. The urinary examination shows, in addition to the pus-cells, polyuria of low specific gravity and acid reaction. Albumin in slight quantities is present and accounted for by pus or blood. If nephritis occurs, considerable quantities of albumin are found, together with granular and hyaline casts. The tubercle bacilli are often difficult to find. Many slides may be examined and none discovered. Pain is not a marked feature of tuberculosis of the kidney, unless the ureter is blocked, preventing the urine from flowing out and damming it back on the kidney. Tumor is difficult to feel, as the kidney is not much enlarged unless pyonephrosis or perinephritic abscess develops. If this occurs, a tumor of considerable size may be easily palpated.

DIAGNOSIS.

In making the diagnosis, the practitioner should *suspect tuberculosis of the kidney in every case of cystitis, especially in young persons, which is not due to stone or stricture and which does not clear up under bladder-washing.* Another point which should increase the suspicion of tuberculosis is the fact that a tuberculous cystitis is always *made worse by bladder-washing with nitrate-of-silver solution.* The failure to find the tubercle bacilli on examining the urine from the bladder does not exclude tuberculosis of the kidney. If the bacillus is found, it is positive evidence of the presence of the tuberculosis; but it is like the proverbial needle in the haystack and many slides may be examined without discovering one. If the microscopic examination of the urine in a case of cystitis or pyelitis shows pus-cells alone, without the presence of micro-organisms of any kind, the absence of any bacteria is strongly indicative that the inflammation is tuberculous in origin. If the tubercle bacilli are found, however, it is a positive evidence and the diagnosis is established. Care should be taken not to mistake the smegma bacillus for the bacillus of Koch, which it closely resembles.

A valuable method of determining the presence of tuberculosis in the body is an injection of tuberculin: 1 c.c. of a 1 : 1000 solution in ½ per cent. carbolic acid, of old tuberculin Koch, is injected hypodermically. If reaction follows within a few hours, and the temperature goes above 102°, it denotes tuberculosis in the body somewhere. The writer has found this to be invariably the case, except in the presence of active syphilis. When syphilis is present, a rise of temperature above 102° occurs following the injection, even when no tuberculosis is present in the body. Another method of applying the tuberculosis test consists in the vaccination of the patient with old tuberculin, full strength (von Pirquet's test), or the use of an inunction of 50 per cent. tuberculin ointment (Morro's test). While the last two named tests are very reliable in children, they are not of much use in adults, for the reason that nearly all grown persons have a focus of healed tuberculosis in them, and this will give a positive reaction when the tests are used.

ANIMAL INOCULATIONS.

The most reliable of all the diagnostic tests are the animal inoculations. Guinea-pigs are inoculated by injecting into the peritoneal cavity a specimen of the urine drawn from the right and left kidney and the mixed bladder urine. After three weeks the guinea-pigs are autopsied, and the presence or absence of tuberculous infection of the pig is proof positive of the condition in the human being.

CYSTOSCOPY AND CATHETERIZATION OF THE URETERS, WITH A COMPARISON OF THE SEPARATE URINES.

Cystoscopy and ureteral catheterization afford great help in making a diagnosis. When the urine is loaded with pus which does not clear up under treatment, and the cystoscope shows the bladder to be fairly normal, the conclusion is naturally drawn that the pus comes from the kidney, and on viewing the ureteral opening a stream of turbid urine may often be seen issuing from one or both ureteral orifices.

Characteristic changes are often observed in the bladder, about the mouths of the ureters. The ureter papillæ are congested and studded with ulcerations or hemorrhages.

Willy Meyer describes the appearance of an edematous pouting or prolapse of the mucous membrane around the ureter, with more or less erosion and hyperemic lesion on the part of its periphery, as pathognomonic of kidney tuberculosis.

It is absolutely essential, before advising any line of treatment, to know the condition of the other kidney, and every possible means should be used to determine its functional capacity before operation is considered.

In order to find the relative secreting capacity of each kidney, the ureters should be first catheterized and the separate urines examined.

There are at present *four methods in use for testing the urine secreted by each kidney,* which are briefly described as follows:—

I. Comparison of Urea Secreted by each Kidney.—It has been proven by experiment that healthy kidneys secrete exactly the same amount of urea during and at the same time, and if one kidney is diseased the excretion of that organ is diminished.

A full quantity of urea would thus show a normal kidney, while a marked diminution in the urea from the other kidney would show disease of that organ.

The urea test commends itself because it is accurate and can be easily carried out with a simple testing apparatus. Rovsing prefers it to the other methods, and in the Long Island College Hospital the author finds this, in conjunction with the indigo-carmin test, entirely satisfactory and does not consider it necessary to use phloridzin or cryoscopy.

II. The Phloridzin Test is based on the fact that phloridzin causes an activity of the kidney-cells which enables them to withdraw sugar from the blood, and on examining the urine we find glucose.

When the secreting power of the kidney is at its highest a large

amount of sugar will be produced, and when the secreting function is impaired less sugar will be eliminated.

Phloridzin Merck, in gr. $\frac{1}{10}$ doses, is injected hypodermically, and the elimination of sugar begins from fifteen to thirty minutes later. The ureters are then catheterized and the urine examined.

Healthy kidneys will generally produce about 1 per cent. of sugar and over, while in defective kidneys the quantity of sugar eliminated amounts to a small fraction of 1 per cent., and in greatest disturbances of the renal function no elimination of sugar can be accomplished.

III. Cryoscopy was first suggested as a means of determining the functional capacity of the kidney by Koranyi, in 1893.

As first used, it consisted in freezing a quantity of the blood and a quantity of the urine from the same patient and comparing their respective freezing points.

The test is based upon the physical law that the freezing point of a fluid is lowered in proportion to the concentration of the solution, *i.e.*, when the solution contains more salts the freezing point is lowered.

The normal freezing point of the blood is constantly from —0.56° to —0.58° C. Any deviation from this point, either higher or lower, shows that the kidneys are not secreting enough and the salts are retained in the blood.

Various conditions besides disease of the kidneys alter the freezing point of the blood:—

I. Absorption of toxins from a malignant growth often elevates the freezing point.

II. Hydremia causes a lowering of the freezing point.

We now know that malignant tumors and uremia interfere with the test of cryoscopy of the blood and falsify the readings.

IV. Chromocystoscopy.—As first suggested by Völcker and Joseph and now used in all the German clinics for detecting diminished elimination in either kidney.

A tablet of indigo-carmin (Brückne, Lampe & Co., Berlin) is dissolved in 10 c.c. of water and injected hypodermically into the buttock, the patient having abstained from water for four hours previously.

In from five to eight minutes a blue stream of urine is seen issuing from the ureter of the normal kidney, and delay in excretion on the opposite side denotes disease with diminished functional activity.

Catheterization of the ureters is not necessary: all that is needed is to keep the mouth of the ureter in view with the cystoscope and wait for the blue stream to appear.

The phenolsulphonphthalein test of Geraghty may also be used in place of the indigo-carmin, but it is less reliable and not nearly so easy to apply.

Comparison of the Tests of Renal Activity.—For practical purposes the comparison of the right and left urines for urea and indigo-carmin will give all the information required as to the relative secreting capacity of each kidney, and the complicated and elaborate tests of phloridzin and cryoscopy will not be required, and indeed are now but rarely used, but before any kidney operation is attempted the surgeon should make every effort to learn the secreting capability of each kidney.

It is in this way alone that we can avoid the fatal error of removing a kidney which, although damaged, may be the only one left to the patient.

In the early stages of tuberculosis of the kidney the bladder is not affected and catheterization of the ureters is not difficult for the surgeon who has familiarized himself with the technique of this operation. In the later stages, after the bladder has become involved in the tuberculous process, catheterization is always difficult and sometimes impossible. The bladder is contracted, containing only 2 or 3 ounces of fluid, and the ulcers bleed freely, completely obscuring the view.

It has always been supposed that ulcerations seen with the cystoscope around the mouth of one ureter denoted an affection of the kidney on the same side, but Rovsing[1] has tabulated 100 cases of tuberculous kidney, and shows that there is no uniformity about the localization of the ulceration, the ulcers being often located around the healthy ureter or about both ureters, even though one kidney may be healthy.

The use of the Luys segregator has been advised in the cases where it is impossible to catheterize both ureters, but unless the bladder is free from ulceration the findings will be misleading, as the urine from kidneys will be contaminated by the pus formed in the ulceration of the bladder.

In the cases which are difficult to examine, the diagnosis has to be worked out step by step. If we can only succeed in getting the urine from one kidney we should endeavor to do so, to determine if the kidney on the side catheterized is healthy or diseased. A view of the ulceration around one or both ureters, together with a decided reaction following the injection of tuberculin, would be sufficient evidence of disease, provided the urine drawn from the bladder showed pus. The presence of tubercle bacilli would be confirmative, but not essential for the diagnosis. In the cases where the diagnosis offers no special difficulty, after the ureters have been catheterized, the right and left urines should be examined. The presence of blood in the urine drawn does not necessarily

[1] Zeitschrift für Urologie, Band 3, Heft 4, 1909.

imply disease on that side, as slight bleeding generally occurs from the traumatism of passing the catheter. The presence of pus in the urine denotes disease of that kidney. A comparison of the urea secreted would show the relative functional capacity of the two kidneys. If the urine from one side shows 10 grains of urea with no pus and no albumin, and

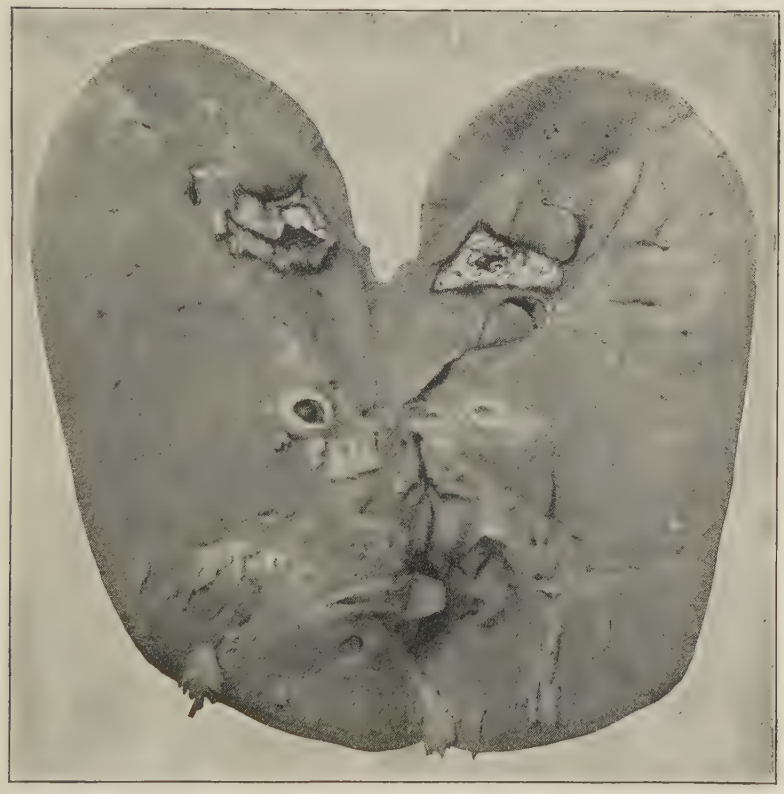


Fig. 219.—Tuberculosis of kidney. Ulceration extending through wall of kidney and perforating into fatty perinephritic capsule, causing a perinephritic abscess to form. Author's case. Nephrectomy. Recovery.

the urine from the other side shows 2 grains of urea with more or less pus and albumin, it is evident that one kidney is healthy and the other is diseased. The presence of sugar after the injection of phloridzin also shows the secreting capacity of the kidney. After the injection of $\frac{1}{10}$ grain of phloridzin, sugar appears in the urine from fifteen to thirty minutes later. The healthy kidney secretes about 1 per cent. of sugar; the secretion from the diseased kidney is less, depending upon the extent

of the disease. Cryoscopy of the right and left urines is very troublesome to carry out and does not throw any more light on the secreting capacity of the kidney than the tests of urea and phloridzin. The cryoscopy of the blood in comparison with the urine is useless on account of the number of conditions which change or modify the relative freezing points of each.

Rovsing found that in one-third of his cases where the bladder was involved the ureters could not be catheterized. The writer has been suc-

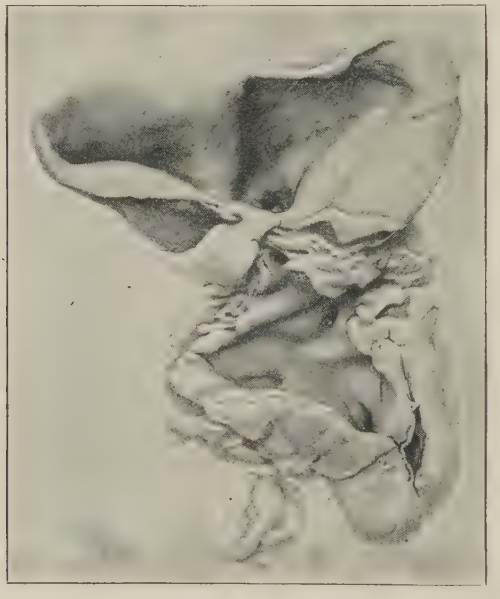


Fig. 220.—Tuberculosis of kidney. Ureter occluded, secreting parenchyma of kidney destroyed, and kidney converted into a mere shell filled with thin pus. Author's case. Nephrectomy. Recovery.

cessful in catheterizing the ureters occasionally in difficult cases with the patient under a general anesthetic, where, on account of irritability of the bladder, it was impossible for it to retain enough fluid.

In the cases when the ureters cannot be catheterized, the indigo-carmin test is very important, for, while we do not collect the separate urines, we can note the delayed blue excretion on one side and in that way determine which kidney is affected.

PROGNOSIS.

The prognosis in tuberculosis of the kidney, if treated expectantly, is bad. Pathologists continually discover old scars of tuberculosis in

the lungs, but old tuberculous lesions of the kidney are never discovered *post mortem*. If the case is left without operation, the kidney condition grows progressively worse, ending in its complete disorganization, together with involvement of the other.

If one kidney is diseased, it should be removed at once,—before involvement of the other kidney or the bladder. In that case the prognosis is good, and the patient's condition begins to improve immediately after the extirpation of the diseased organ.

The great advancement in the modern treatment of tuberculous kidney is due to Nitze's invention of the cystoscope. In former times it was not possible to determine the functional capacity of the other kidney, and the mortality of nephrectomy was very high. According to the statistics collected by Küster, the mortality of 223 nephrectomies through the loin ranged from 36 to 52 per cent. Since the introduction of modern methods of diagnosis, by which the capacity of the other kidney can be determined, Watson and Cunningham have collected the statistics of 292 cases, with a proportionate mortality of 8.8 per cent. These statistics have been further analyzed by Watson and Cunningham, showing as follows: 54 per cent. of patients were cured; 19 per cent. died after convalescing, half from the disease, the others from other maladies; 36 per cent. showed great improvement, but not a cure.

In double-sided disease the outlook is very grave.

The course of a case which is not operated upon is generally slow. It lasts a considerable time, often several years, before the parenchyma is so much destroyed that the secreting function is badly impaired. Usually metastatic deposits with general tuberculosis occur, and when this takes place the fatal issue is rapidly reached.

In the course of kidney tuberculosis the perinephritic tissue becomes involved, suppuration takes place, and perirenal abscess forms.

The symptoms are acute, and consist in pain ful tumor in the kidney-region, with chills and fever and great prostration.

TREATMENT.

When both kidneys are affected with tuberculosis, or one is tubercular and the other badly disorganized from chronic Bright's or amyloid degeneration, the treatment can only be directed to the palliation of symptoms, and consists in forced nutrition, irrigation of the bladder, and, internally, urotropin, gr. viiss *t. i. d.;* with narcotics to relieve pain.

In the case where pyonephrosis forms, and as a result of the accumulation of pus in the kidney the patient suffers from severe sepsis from absorption, and it is evident that death will occur unless the

kidney is opened and drained, a nephrotomy should be done and the pus evacuated.

If the other kidney is diseased, complete extirpation, or nephrectomy, is manifestly impossible, and the operation of nephrotomy is undertaken merely as a palliative measure.

The wound should be left open and allowed to heal by granulation, and usually a permanent fistula remains. The evacuation of the pus, however, relieves the patient of his urgent symptoms and prolongs his life.

When, however, one kidney alone is affected with tuberculosis, and the patient comes under observation early, before the second kidney is involved, it is advisable to remove at once, and completely, the diseased organ.

Even a moderate bladder or lung tuberculosis, if not too far advanced, is not a contraindication for operation; the bladder heals, or at least improves, when the source from which the tuberculous material is poured into it is removed.

It has sometimes been the practice in past years to wait for a spontaneous healing of renal tuberculosis to take place; and while this sometimes happens in rare instances, it is so unusual that it cannot be depended upon, and in most cases which are left alone the process extends to the other kidney and to other organs.

Perinephritic abscess forming as a result of tuberculous kidney calls for surgical treatment at once. The pus must be evacuated by a free incision, and the treatment of the kidney itself depends upon the condition of the other one.

TUMORS OF THE RENAL PARENCHYMA.

Well-authenticated cases of renal carcinoma, sarcoma, and malignant adenoma are so few that it is impossible to give any data in regard to their etiology. By far the most important tumor affecting the kidney is **hypernephroma.**[1]

Of recent years the pathological investigations on this tumor have been widespread, although formerly sarcoma and carcinoma have been generally confounded with it.

Hypernephroma may, then, be discussed as the type of malignant tumor affecting the kidney, as in the rare cases of sarcoma and carcinoma the symptoms and treatment are identical, and a differential diagnosis can only be made by removing the kidney by operation or at the autopsy table. Hypernephroma was first described by Grawitz, in 1883, and his

[1] "Tumors of the Kidneys," Garceau. Appleton, 1909.

conclusion was that the tumor originated from aberrant adrenal tissue (adrenal rests), which is so frequently found in the kidney.

When the tumors are small in size they may remain latent in the kidney for years, although they may give rise to metastases which result in death. It is the accepted opinion today that all hypernephromata should be considered malignant because they may assume a malignant character and give rise to metastases.

The duration of the disease is variable. In cases which are not

Fig. 221.—Hypernephroma of kidney.

operated upon, the duration may be five or six years or more, but, as a rule, the discomfort is endured about two and one-half years before nephrectomy is submitted to.

The early appearance of metastases shortens the disease, especially when important organs are affected, and the diagnosis of hypernephroma has often been made from examination of the bone tumor which has been removed by operation.

SYMPTOMS AND DIAGNOSIS.

An early diagnosis is of the utmost importance to the life of the patient, as, if the kidney is removed soon enough, metastatic deposits will not take place in other organs.

On this account every instance of bleeding from the kidney should be regarded with attention, the ureters catheterized, and the functional capacity of each kidney tested.

The tests for renal functional activity of each kidney show that, when the secreting cells have been destroyed and replaced by a new growth, the secreting capacity of that kidney is less than the one on the other side.

The *symptoms* of hypernephroma may be tabulated as follows:—

(*a*) Pain in the kidney region, more or less inconstant.

(*b*) Presence of a tumor.

(*c*) Hematuria.

(*d*) Cachexia of cancer.

(*e*) Sudden appearance of varicocele.

(*f*) Rheumatic pains in different bones, and enlargement of lymphatic glands.

Considering the above symptoms in detail of **the changes in the urine** which may occur, the appearance of blood in the urine is the only reliable symptom; while pus-cells are often found, they have no particular significance and are due to secondary infection.

The appearance of epithelial cells under the microscope is of little diagnostic importance, for the various cells, both normal and pathological, from the kidney, become altered by prolonged contact with urine and are no longer typical.

Albumin and casts may be found after secondary nephritis has occurred.

The hematuria may be very free, or may be so scanty that it is only perceptible with the microscope.

It is, of course, of the utmost importance to determine from which kidney the blood issues. This can be done by cystoscopy; the blood may be seen issuing from the mouth of the ureter, or the two ureters may be catheterized.

The bleeding has certain characteristic features to distinguish it from other forms of hemorrhage. It comes on suddenly and without any assignable cause, is uninfluenced by treatment, and ceases without any apparent reason.

The hemorrhage usually occurs early in the disease, but sometimes the tumor exists for some years unnoticed, and the patient's attention is only called to it by a free hemorrhage.

Cachexia is a constant symptom and occurs in nearly every case. The emaciation is marked, and on inspection it is evident that the patient is suffering from a serious affection.

The presence of a tumor is, of all, the most certain symptom, and it can usually be felt under the free border of the ribs. It is often possible to decide by palpation whether its surface is smooth or lumpy, and also its approximate size.

The tumor may be confounded with other organs in the neighborhood, such as the liver, gall-bladder, intestine, spleen, ovaries, ureters, and large uteroperitoneal lymph-glands.

If the cancerous deposits consist of small nodes lying deep within the kidney tissues, they cannot be felt; or the kidney may be so high up behind the ribs that it cannot be palpated.

It will be seen then that the disease must be well advanced before the tumor becomes large enough to be easily felt.

Varicocele.—Guyon calls attention to the rapid appearance of a varicocele on the affected side, due to pressure of the tumor on the spermatic veins. This symptom is very inconstant.

Pains in various bones are often noticed late in the disease, and are usually due to metastatic deposits in the bones. When these have occurred it is too late for any operative treatment to be of value.

DIFFERENTIAL DIAGNOSIS.

While a typical case of well-developed hypernephroma can be easily diagnosed by the presence of a tumor, cachexia, and hematuria, it is often difficult to differentiate beginning malignant disease from other conditions which may give rise to hematuria.

Idiopathic or essential renal hematuria may originate from various causes, which have been classified by Keyes[1] as follows:—

1. Hematuria—scurvy purpura.
2. Drug poisoning (turpentine, cantharides, etc.).
3. Parasites (*e.g.*, distoma, hematobium—Sondern).
4. Acute or chronic febrile diseases (scarlet fever, malaria).
5. Surgical diseases (hydronephrosis, nephrolithiasis, renal mobility).
6. The passage of urinary crystals.
7. Angioneurosis.
8. Chronic nephritis.
9. Traumatic rupture of the kidney.

A close study of the case may succeed in establishing a positive diagnosis; but we ought not to suspend our efforts to make a diagnosis merely because the hemorrhage has stopped, for if the bleeding is due to hypernephroma it will surely return, and when it does so the time for operation

[1] "Surgical Diseases of the Genitourinary Organs," 1903.

will very likely be past. Hence it is that, after exhausting the ordinary means of diagnosis by palpation, cystoscopy, and catheterization of the ureters, microscopic and chemical examination of the separate urines, if there is still a doubt in the surgeon's mind as to the cause of the bleeding, it will certainly be better for the patient, to do an exploratory nephrotomy. If the condition of the kidney, on examination, makes it advisable, the operation can then readily be converted into a nephrectomy.

The prognosis, without operation, is bad, and unfortunately the diagnosis is often made after secondary deposits have occurred, when operation is, of course, useless.

For this reason the patient's life depends upon making an early diagnosis, and before metastasis has occurred in other organs.

The only **treatment** which can be considered is *nephrectomy*, provided there are no metastatic deposits in other organs, that the other kidney is functionally competent, and that the heart and general condition will admit of a severe operation.

METHOD OF EXAMINATION FOR SUSPECTED DISEASE OF THE KIDNEY.

History.—*Family history* of tuberculosis, cancer or gout.

Previous Diseases.—Pulmonary or genitourinary tuberculosis, gonorrhea, stricture, cystitis, attacks of renal colic, passage of gravel-stone, vesical calculus. If the patient is an old man, enlarged prostate and retention of urine.

Present Symptoms.—Pain; frequent urination, whether most marked by day or night; hematuria, pyuria, quantity of urine passed, variations in quantity, and fluctuations in amount of pus and blood.

Physical Examination.—Palpation of kidney for tumor or tenderness.

Examination of urine drawn from the bladder, for reaction, turbidity, specific gravity, albumin, sugar, and urea.

Microscopic examination of centrifugated sediment for epithelial cells from kidney, casts, crystals, pus, blood, and micro-organisms.

Differences in Urines of Cystitis and Pyelitis.

Cystitis.	*Pyelitis.*
Specific gravity, normal.	Specific gravity, low.
Reaction, alkaline.	Reaction, acid.
Albumin, scanty.	Albumin, greater quantity.
Pus, abundant.	Pus, less in quantity.
Casts, absent.	Casts, present.

Cystoscopic Examination of Bladder.—Exclude vesical calculus, tumors, cystitis, ulcerations of bladder, enlarged prostate. Note ureteral orifices. Inject indigo-carmin and watch for blue stream from ureters.

Catheterize Ureters.—Examine right and left kidney urines, and compare.

Microscope.—Look for kidney epithelium, casts, pus, blood, crystals, and micro-organisms.

Chemical examination, for albumin, urea, and sugar, if phloridzin was injected.

Physical Examination.—Cryoscopy. Indigo-carmin and phenolsulphonphthalein.

Radiographic picture, if calculus suspected.

Inject peritoneal cavity of guinea-pig, with urine from bladder or kidney if tuberculosis suspected.

Finally, if impossible to make diagnosis otherwise, **exploratory nephrotomy.**

A tabulation of the objective and subjective symptoms of renal lesions has been arranged as follows by Charles L. Gibson[1]:—

Abnormal Mobility.—History: recognition of displacement by examination; associated neurasthenia and gastroenteroptosis; direct and indirect pain.

Hydronephrosis, Unilateral.—Antecedent history of blocking of one ureter, usually by a calculus; large, painless, rounded, fluctuating tumor in the loin; absence of constitutional and uremic symptoms; compensatory hypertrophy of the other kidney.

Pyelonephritis or Surgical Kidney.—Usually history of long obstruction, plus infection; mostly elderly men with obstructing prostate and men in middle life with stricture; recognition of the obstruction and cystitis; a low-grade chronic sepsis; occasional acute exacerbations with chills and febrile disturbances; chronic diffuse nephritis; seldom any enlargement or tenderness of the kidney; usually bilateral.

Tumors.—Age: sarcoma in infancy, hypernephroma in later life; cachexia; tumor; pain, hematuria.

Hydronephrosis, Double.—History usually of chronic obstruction to the escape of urine from the bladder, or of malignant growth pressing on both ureters; recognition of the source of obstruction.

Pyonephrosis.—Antecedent history of infection and obstruction; large globular and fixed tumor in the flank, which is tender on pressure; if process was acute, febrile and other constitutional symptoms; pyuria, which resists all treatment of the bladder, and absence of all symptoms referable to the bladder.

[1] Medical Record, January 7, 1905.

Renal Calculus.—The passage of sand, gravel, or small calculi; typical renal colic; attacks of hematuria, especially if accompanying renal colic; symptoms of suppuration in the kidney; local pain and pyuria; recognition of an enlarged kidney due to pyelitis or hydronephrosis; excess of crystalline sediment; temporary oliguria followed by polyuria; gouty or rheumatic diathesis and chiefly in middle-aged individuals.

Tuberculosis.—History of constitutional tuberculosis; other tuberculous foci, especially of the genitourinary tract; persistent evening rise of temperature; very insidious and latent course of symptoms; polyuria from chronic diffuse nephritis; frequency of urination, even in earlier stages before marked changes in bladder; irregular hematuria without apparent cause; pus thoroughly mixed with urine of an acid reaction.

OPERATIONS ON THE KIDNEY.[1]

To Simon is due the credit of havnig first removed the kidney through an incision in the loin without entering the peritoneal cavity, and this is the method of choice which is applied to nearly every case today.

The transperitoneal approach to the kidney was also experimented with, but is now abandoned in general and only reserved for very exceptional cases, for the lumbar route is less dangerous to life, less damaging to the tissues, as it affords the most direct approach to the kidney and offers inestimable advantages for the after-treatment.

The kidney in its normal position lies with its greater part concealed by the borders of the ribs, only about one-third of its substance lying below them. On this account it is impossible to expose the kidney freely without dislocating it and bringing it downward from its bed into the wound. As a rule, the right kidney lies somewhat deeper than the left and is more liable to become movable.

The pedicle of the kidney is composed of the vein, artery, and ureter, the artery lying behind and the vein in front. Aberrant vessels are often found, particularly accessory veins, which course from the pelvis out to the parenchyma.

The pedicle is so inelastic at times that even after all the adhesions are freed it is very difficult to bring the kidney up on a level with the surface of the wound.

The ureter runs from the pelvis diagonally downward upon the psoas major, crossing the iliac artery just before it reaches the bladder.

The kidney is closely surrounded by a thin capsule of fibrous tissue (the capsula propria), and this is again enveloped in a fatty capsule (capsula adiposa), which is of varying thickness.

On exposing the kidney the fatty capsule is torn away, but the capsula propria remains.

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[1] Victor Schmieden: "Chirurgische Operations Kursus," Leipzig, 1910.

Reference to the illustration shows the relation of the peritoneum, and the arrow denotes the route by which the kidney can be reached without opening the peritoneal cavity.

The lateral wall of the erector spinæ, which can often be felt, serves as a landmark for the posterior border of the incision; more anteriorly the three layers of the oblique abdominal muscles come into view, and if the incision extends upward a larger part of the latissimus dorsi appears in it. The transversalis fascia stretches between the muscles and the kidney fat.

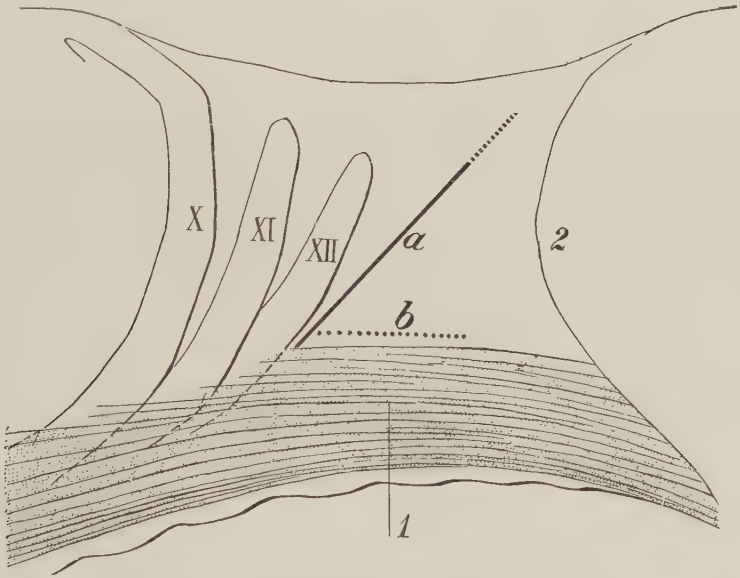

Fig. 222.—Lines of incision for exposing kidney. *a*, oblique incision, may be extended along dotted line; *b*, longitudinal incision of Simon; 1, erector spinæ or sacrolumbalis; 2, crest of ilium.

In Fig. 222 the two forms of incision in common use are shown:—

(*a*) *The Longitudinal Incision of Simon on the Border of the Erector Spinæ.*—It begins at the border of the twelfth rib and extends directly downward; none of the muscles are cut through, and the peritoneum is at a considerable distance from it.

While it causes but little damage to tissues, it permits only a limited exposure, and it is only possible to bring out of the wound a kidney which is small and not abnormally fixed.

For this reason the Simon incision is only used today in cases where it is not necessary to bring the kidney out on the flank, as in nephropexy and incising perinephritic abscesses.

(*b*) *The oblique incision of von Bergmann* is the one in general use today, although many operators have slightly modified its direction.

The patient lies upon the sound side, supported upon a half-round wooden block so that a wide space exists between the ribs and the ilium.

The incision is begun at the junction of the twelfth rib and the erector spinæ muscle about 3 fingerbreadths from the spine and extends obliquely downward and forward just below and parallel to the twelfth rib.

The incision divides the skin, fascia, and last fibers of the latissimus dorsi, exposing the lateral border of the erector spinæ; from this point the oblique abdominal muscles are cut layer by layer and then the transversalis fascia, taking great care not to wound the peritoneum.

The iliohypogastric nerve is seen coursing over the quadratus lum-

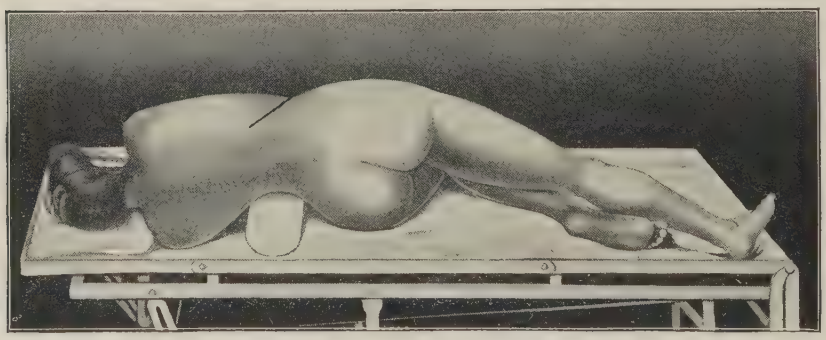

Fig. 223.—Patient in position for exposure of the kidney.

borum; it is pushed backward and held, together with the divided muscles, by a blunt retractor.

The position of the kidney is then made out by palpation.

The index fingers of both hands are then introduced into the kidney fat and the fatty capsule exposed. The capsule is grasped with anatomical forceps and a small incision made in it; the index fingers are introduced into the opening thus made, and the fatty capsule is torn through in a longitudinal direction and the kidney palpated.

The anterior layer of the fatty capsule, together with the peritoneum, is pushed forward and held out of the way with a blunt retractor; in this manner the peritoneal cavity is protected from being accidentally wounded during the entire operation.

The surgeon's hand is then introduced into the wound, and separates the kidney from its fatty capsule, which remains *in situ*, and the attempt is made to draw the kidney up out of the wound.

This maneuver can be aided by an assistant making firm counter-pressure over the abdomen with the closed fist.

After the kidney has been brought out of the wound on the flank, the remainder of the imbedding fat is pushed back, bringing into view the pelvis, the blood-vessels, and the ureter.

After completing the operation on the kidney, the steps of which are described subsequently, it only remains to close the wound cavity.

It should be remembered that a distinct disposition to lumbar hernia remains, as the divided abdominal muscles and fascia do not always unite firmly and a subsequent operation for hernia may have to be undertaken. For this reason it is necessary to unite all the layers divided, by means of sutures.

Partial drainage of the wound is required in most cases, the excep-

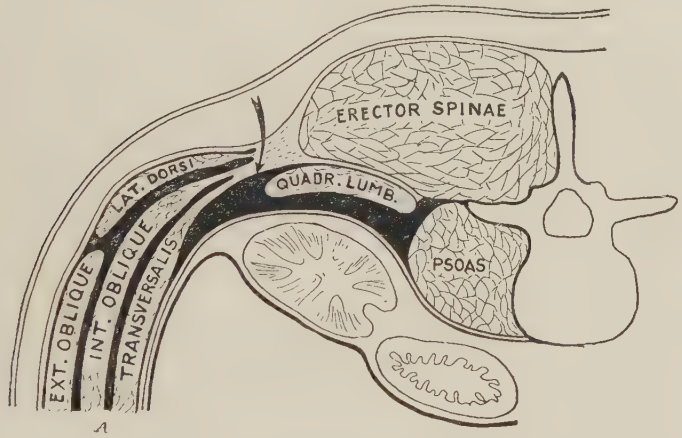

Fig. 224.—Diagram of section through region of loin at height of twelfth rib. The arrow shows the route of approach to the kidney, retroperitoneal, with least injury to the muscles. (After *Schmieden.*)

tions being in a simple exploratory operation where the kidney is found to be healthy, and only then when it was possible to stop all hemorrhage and when the kidney-substance was not injured.

The cavity remaining after a kidney extirpation always requires temporary drainage and a tampon, as well as the cases where the kidney was incised.

In the presence of infectious processes the wound should be treated open and filled with a Mikulicz tampon and only the anterior part sewed, the drainage-tube and tampons being brought out from the posterior angle of the wound in the region of the erector spinæ.

The freeing and dislocation of the kidney as above described are often attended with considerable difficulty, especially in the case of individuals

with fat abdomens or with large tumors of the kidney, and especially in the cases where the kidney is considerably enlarged and adherent to the neighboring structures or imbedded in a heavy mass of cicatricial tissue.

In such cases the isolation and exposure of the pedicle may be attended with extreme difficulty, and the following measures will prove of assistance.

In the first place the incision may be prolonged as far forward as is desirable, in extreme cases to the rectus abdominis, dividing at the same time the peritoneum.

This temporary division of the peritoneum for large tumors is often very helpful, and is sometimes made solely for the purpose of palpating the kidney on the other side.

The peritoneal cavity should be closed as soon as possible, and accidental wounds of the peritoneum sutured at once.

The incision may be prolonged posteriorly by partial division of the edges of the erector spinæ and quadratus lumborum, and a great deal of extra space can be secured by resection of the twelfth rib; to avoid wounding the pleura the resection must be made after stripping up the periosteum, and it should be remembered that the pleural cavity sometimes extends below the twelfth rib.

In spite of these measures, it sometimes happens that the delivery of an enlarged kidney is impossible. In such cases, where the kidney is a solid tumor it may be removed by subcapsular enucleation, leaving the thickened and fatty capsule adherent to the surrounding tissues.

Large cystic tumors or hydronephroses are first emptied by means of the Potain aspirator, and when the fluid is removed they are transformed into a collapsed sac, which allows itself to be easily withdrawn through a small opening.

The exposure of the ureter in its upper part is easily attained by means of the incision above described for the kidney. The lower part may be brought into view by a prolongation of the oblique lumbar incision; in the middle axillary line the incision departs from the direction of the twelfth rib, and is carried forward over the anterior superior spine and as far forward as necessary, above and parallel with Poupart's ligament.

In this way it is possible to inspect the entire ureter and incise it and remove a stone if present; with the aid of this incision one can also remove the entire diseased ureter from the kidney to the bladder in cases of nephrectomy for tuberculosis.

The exposure of the lower third of the ureter requires an entirely different approach and is only called for in the case of ureteral calculus impacted in the pelvic portion of the ureter.

The patient is placed in the Trendelenberg position and an incision parallel with Poupart's ligament and one inch above it made from the spine of the ilium to the inguinal ring. The skin, fat, and muscles are divided down to the peritoneum, which is not opened. The peritoneum is pushed back until the iliac artery is clearly seen at the bottom of the wound.

The ureter will be seen crossing the bifurcation of the common iliac, and this serves as the landmark for it. The ureter will be found adherent to the peritoneum and lying like a white band of tape within its folds.

The ureter can be examined with the fingers, and when the stone is felt the ureter should be incised in its long axis, not at the point of dilatation, but a short distance from it, so as to secure healthy tissue for the subsequent suture.

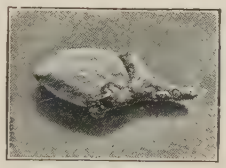

Fig. 225.—Calculus of ureter of several years' duration. Removed by extraperitoneal route. Author's case.

The stone may be grasped with alligator forceps and removed and the wound in the ureter closed with catgut sutures, which should be left long and used to tie around the end of a gauze tampon to keep it in close contact with the incised ureter and prevent it from being pulled out accidentally. When the catgut softens, the gauze comes away. The wound in the abdominal wall is then closed in the usual manner, except at the lower angle, where the gauze protrudes.

Some leakage of urine always occurs, but ceases when the wound in the ureter fully unites, as it always does, for longitudinal wounds of the ureter heal readily without leaving a fistula.

Nephrotomy and Nephrolithotomy.

The operation is begun by luxating the kidney through the oblique incision already described; after this is accomplished, the kidney is examined to see if a focus of disease is perceptible to the touch or vision, and the pelvis of the kidney is palpated for a stone.

A stone which is present in the substance of the kidney may be found by transfixion with a thin, straight needle introduced at various suspected points.

A clear understanding of the condition of the parenchyma and the kidney pelvis can best be obtained by splitting the kidney longitudinally.

Since Zondek's investigations of the blood-supply to the kidney the incision should be made ½ to 1 cm. behind the anatomical median line, so that the posterior half is smaller than the anterior, as in this way fewer large vessels are injured.

Before incising the kidney a pedicle clamp, both blades of which are protected by rubber tubing drawn over them should be placed upon the vessels; otherwise, the hemorrhage is very free, rendering inspection difficult. The clamp should not include the ureter, as this would interfere with the introduction of a sound for exploratory purposes.

The incision should lay open the pelvis of the kidney, and is fol-

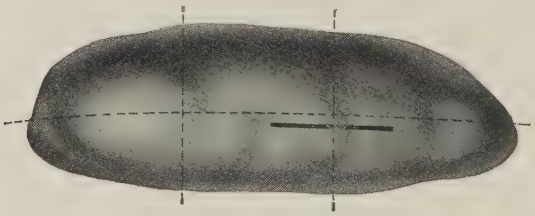

Fig. 226.—Line of incision in nephrotomy for exploring pelvis of kidney. (After *Albarran.*)

lowed by inspection of the parenchyma, extraction of stones, and before finishing a long probe or bougie à boule No. 16 should be passed down the ureter to detect a ureteral calculus.

If the kidney is not to be extirpated the incision should be partially or entirely closed with sutures.

Several mattress sutures of catgut should be placed to hold the cut surfaces in place and control the bleeding, and finally a continuous catgut suture passed through the capsule and edges of the incision to hold them together.

Care must be taken not to draw the sutures too tight; otherwise, they will tear out of the tender parenchymatous tissue.

The pedicle clamp is removed and the amount of reactive hyperemia noted.

In infected cases it is safer to introduce a drain between the sutures, and the wound in the flank is also left partially open and drained. For exploration of the kidney pelvis and removal of a small stone from it a short incision is sufficient; the examining finger is

introduced through it, the incision held open with blunt retractors, and the stone removed with lithotomy forceps.

Such incisions should be sutured in the same manner as the larger ones, and the same principle is applied to suturing a ruptured kidney when it is to be saved.

With septic processes, or with sacculated kidneys which cannot be extirpated, it is proper to return the kidney to its bed without suturing, provided it be filled with gauze tampons or the edges of the kidney incision sutured to the edges of the skin (nephrostomy).

In cases of nephrotomy where the surgeon fears the danger of secondary hemorrhage, two long gauze strips may be placed under

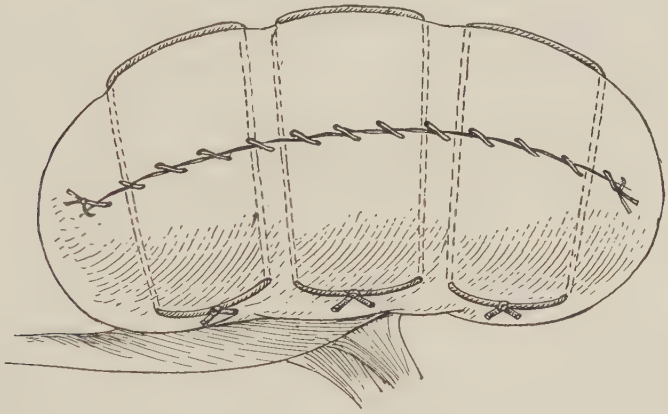

Fig. 227.—Method of suturing a kidney. Continuous suture through edges of incision and mattress sutures, if necessary to control hemorrhage.

the kidney at its upper and lower poles and the ends brought out of the wound.

If hemorrhage occurs, the kidney may be raised up, brought out of the wound by drawing on the ends of the strips, and the hemorrhage controlled or the kidney extirpated (Bockenheimer).

Pyelolithotomy

is adapted to small stones lying in the pelvis of the kidney, and has the advantage of not causing drainage to the parenchyma or much hemorrhage.

The kidney is exposed and brought out on the flank, and an incision is made in the upper end of the ureter, which may be extended upward with the pelvis of the kidney if necessary and the stone grasped and removed with lithotomy forceps.

A rubber drainage-tube should be inserted through the wound in the ureter, into the pelvis of the kidney, and the wound in the ureter closed around it with Lembert sutures of catgut. Silk should never be used in any kidney incision, on account of the danger of urinary concretions forming.

Nephrectomy.

The kidney is exposed and brought out upon the flank as already described. If necessary, a nephrotomy may be done, and if it is decided to remove the kidney the most important part of the operation consists in the *treatment of the pedicle.*

The vein, artery, and ureter should be brought into plain view by pushing away the surrounding fat with gauze sponges or preparation with anatomical forceps.

When the exposure is complete the ureter should be tied with a double ligature and cut between them or preferably burned through with the Paquelin cautery.

Fig. 228.—Deschamp's ligature carrier.

The artery and vein are best dealt with by passing a heavy silk ligature by means of a Deschamps ligature carrier around each separately and tying firmly. The pedicle is grasped between the knot and the kidney with a Kocher clamp and the kidney cut off above it with scissors. The ligatures should be placed as far from the kidney as possible, so that a long stump is left to prevent the danger of the ligature slipping off.

After the kidney is cut away, the pedicle, which is held by the Kocher clamp, is inspected for hemorrhage and the vessels ligated again for security, and the pedicle is allowed to drop back only after the surgeon has assured himself that the hemorrhage is controlled.

Great difficulties may be encountered in ligating the vessels in the case of a short pedicle or one which is imbedded in cicatricial tissue.

In such an instance the vessels must be seized with a clamp as low down as possible, while an assistant holds the clamp firmly, for if it slips after the kidney is cut away uncontrollable hemorrhage occurs. The kidney is then cut away and the artery and vein picked up and tied separately.

A mass ligature should never be applied with the clamp in place, as there is always the danger that the mass of tissue is so thick that the ligature will not hold, but will slip off.

If these maneuvers are not successful and more space is needed for the ligation, it is safer to resect the twelfth rib, which will give ample room for the manipulations (Braun).

Nephropexy.

The longitudinal incision of Simon at the border of the erector spinæ is well adapted to this operation, which can be considered in two parts:—

(*a*) The replacement of the organ in its normal position.

(*b*) Securing it in place.

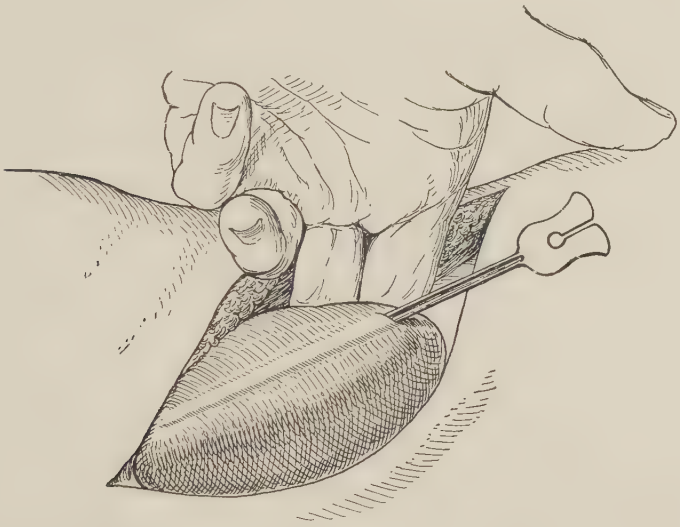

Fig. 229.—Nephropexy. A grooved director is passed under fibrous capsule of the kidney, preliminary to stripping it off.

The Simon incision is held apart with retractors, and the kidney exposed on its convexity and a part of its posterior surface, and held in place by an assistant.

For its fixation innumerable methods have been invented and described, demonstrating how unsuccessful the results of fixation often are.

For a successful operation it is necessary that neither fat nor blood-clots interpose between the kidney and the posterior abdominal wall to prevent the close adhesion, and that a strong cicatrix forms between the kidney-substance and the abdominal wall.

It is desirable to cut away as much of the fatty capsule from the wound as possible in every form of operation for fixation of the kidney. The three methods in common use today are described as follows:—

Guyon's Method.—The kidney is partially decapsulated by stripping off the fibrous capsule from its convexity and part of the anterior and posterior surfaces.

The first suture is passed around the twelfth rib and through the parenchyma of the kidney by means of a Reverdin needle.

The second suture is passed through the muscle on the anterior surface

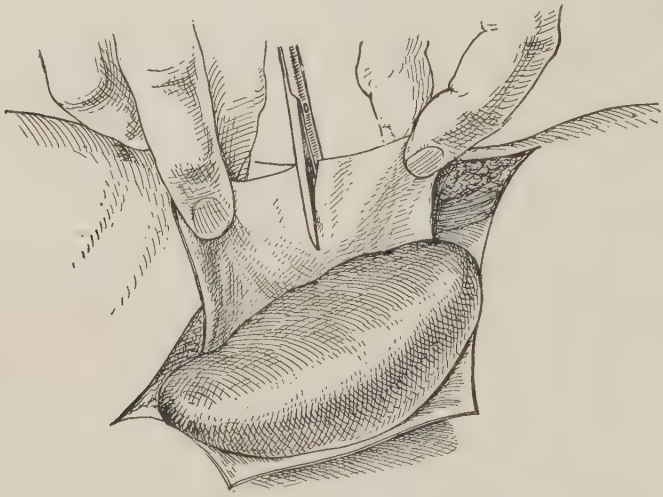

Fig. 230.—Nephropexy. Albarran's method. The anterior part of the fibrous capsule is split in two halves.

of the wound, through the kidney, and through the muscle on the posterior surface of the wound.

The external wound may be closed without drainage.

In order to avoid passing the suture through the kidney-substance, and the possible danger of the formation of concretions, the following method is preferable:—

Fig. 231.—Reverdin needle.

The method of Obalinski is also successful, and has the advantage of avoiding the sutures passed through the kidney parenchyma.

The object of the operation is to prevent primary union of the outer wound and cause the formation of a firm cicatrix, which fixes the kidney in place and attaches it to the skin.

After exposing the kidney a small part of the proper capsule is stripped off to make a raw surface to form adhesions.

The fatty capsule is sutured to the muscles, and if possible the sutures are carried through the loosened capsula propria. The skin wound is not closed, but kept open by a gauze tampon, which is left in place for a week. The wound heals by granulation, forming a firm, strong scar extending from the kidney to the skin, fixing the organ and holding it in place.

The patient must remain in bed for three weeks.

Albarran's Method.—The kidney is exposed by the oblique incision, and the capsula propria is entirely stripped off from the kidney, forming an anterior and a posterior flap.

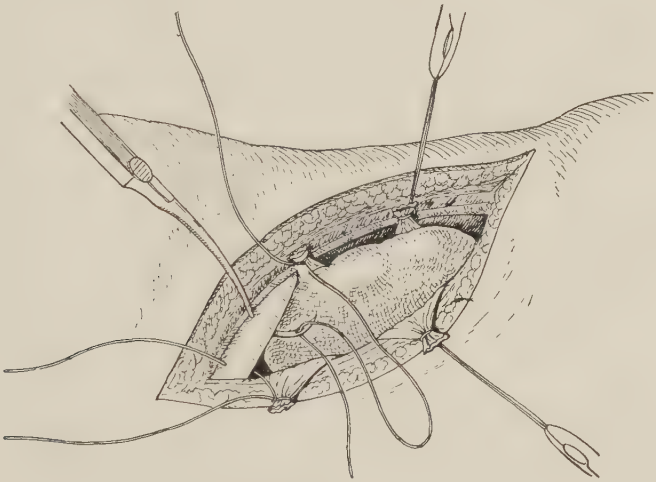

Fig. 232.—Nephropexy. Albarran's method. Sutures attached to stump of decorticated capsule. Upper sutures passed around twelfth rib and lower sutures through muscular margins of wound.

The anterior and posterior flaps are each divided into two halves and tied with chromicized catgut, leaving the ends long.

The twelfth rib is exposed and the two upper sutures passed around it with a Reverdin needle, and the ends tied, fixing the kidney in place. The two lower sutures are then passed through the muscles at the edge of the incision and the ends tied in the same way.

The operation is finished by introducing a small drain (Albarran) and closing the wound with buried sutures.

RESULTS OF OPERATIONS ON THE KIDNEYS.

In no class of surgical cases is the reduction of mortality, due to improved operative and diagnostic technique, more striking than in operations on the kidney.

The statistics as presented by Küster are most instructive. In the years 1861 to 1869, nephrectomy was done on 5 patients, with a mortality of 80 per cent.

In 1882, Harris reported 50 cases, with a mortality of 38 per cent.; while in 1902 the collected reports of Küster on 1067 cases of lumbar nephrectomy show a reduction in the death rate to 12.08 per cent.

Küster's records also show that nephrectomy by the abdominal route has a mortality of 34 per cent., or nearly three times as great as when the operation is done through the loin without opening the peritoneum.

Results of Nephrotomy and Nephrolithotomy.—The mortality of nephrotomy, for various conditions, can be noted by reference to Küster's collected statistics:—

For pyelonephritis, 92 cases operated, 17.39 per cent. died.
For renal calculus, 487 cases operated, 18.27 per cent. died.
For cysts of kidney, 150 cases operated, 6.66 per cent. died.

It is evident from these figures that the cystic kidney offers the best prognosis for operation, not because nephrotomy *per se* is less formidable than for other conditions, but the disease in itself is one which does not immediately threaten life.

Nephrotomy for calculus or pyelonephritis, on the other hand, is attended with a higher death rate on account of the extreme damage to the secreting structures of the kidney, the depreciation of the patient's vitality, and the danger of prior involvement of the other kidney.

Results of Nephropexy.—The results of these various methods will probably be found to compare favorably one with another, although Henry Morris, Tillmanns, Tuffier, Keen, and others believe that passing the sutures through the parenchyma of the organ furnishes a larger percentage of successes than other methods of procedure.

The mortality of the operation is very slight, running from 2 to 4 per cent. when it is performed under favorable auspices.

According to Albarran, in 88 per cent. of the cases which recovered, the pain was cured. In 14 per cent. nervous symptoms were partially cured; but 36 per cent. were not benefited in this respect.

Keen reports 134 cases of nephrorraphy, and of the cases treated by suture of the fatty capsule only 26.6 per cent. were failures; of those treated by suture of the fibrous capsule alone, 25.9 per cent. were failures, while in those treated by suture involving the kidney substance only 13.5 per cent. were failures.

Watson and Cunningham's statistics of 158 cases reported show much more favorable results than the above. The analysis shows the following:—

Absolute cures	132
Great improvement	18
Failures	8
	158

The patients were under observation from one to twenty years after the operations were performed.

RENAL DECAPSULATION IN BRIGHT'S DISEASE.

Within very recent times the interest of surgeons has been strongly directed toward the cure of chronic nephritis by stripping off the capsule of the kidney.

A brief history of the development of the operation may not be out of place.

In 1896, R. Harrison[1] reported 3 cases of patients suffering from nephralgia and hematuria where the kidney was cut down upon in the expectation of finding a renal calculus or pyelitis. No obvious cause for the symptoms was discovered, but the pain, hematuria, and albuminuria disappeared after the nephrotomy, and the patients completely recovered.

Harrison attributed the success of the operations to the relief of tension accompanying the inflammation of the kidney, which followed a division of the kidney.

He also drew the conclusion that interference with an inflamed kidney on one side benefited the function of the other, and explained it by assuming that there was a sympathetic connection between the two kidneys.

Israel[2 3 4 11] also reports cases of unilateral hematuria or nephralgia upon which he did nephrotomy which were supposed to be due to calculus, but were in reality cases of chronic Bright's disease.

Of 14 cases which he operated upon, 2 died of severe double nephritis, and 6 recovered completely. In 3, the symptoms recurred after prolonged intervals, and in 2 the nephrotomy was a failure.

Israel disclaims any intention of curing chronic Bright's disease by operation, in general, and regards nephrotomy as indicated only in cases of hematuria and nephralgia where the symptoms become severe and medically uncontrollable.

He believes that the relief of the symptoms is due to a lessening of the intrarenal pressure within an unyielding capsule, which interferes with or suppresses blood-circulation and urinary excretion.

He accounts for the disappearance of all the symptoms when only one kidney has been operated upon by assuming that the disease is confined to one kidney and that the other is healthy.

He calls attention to the well-known fact that a tissue which is the seat of chronic inflammation usually takes on healthy action when the diseased structures are split, and he believes that after nephrotomy new venous channels form between the kidney and surrounding structures, in this way relieving congestion and lessening the intracapsular pressure.

Pousson[5 6] also reports cases of chronic Bright's disease where nephrotomy was done by himself and others.

He explains the good results obtained by assuming that the nephrotomy relieves the pressure and permits the secreting cells of the kidney which are still undamaged to resume their function.

Pousson, however, is of the opinion that nephrotomy should only be done in desperate cases of uremia where the usual medical treatment has entirely failed.

Edebohls,[7 8 9 10] of New York, was the first surgeon to operate on cases which had been diagnosed as chronic Bright's disease with the object of curing that condition by operation.

While in England, France, and Germany surgical measures were undertaken for the relief of renal hematuria and pain, or of desperate cases of uremic poisoning, in this country Edebohls conceived the idea from his work in anchoring movable kidneys, and observing the improvement which occurred in the accompanying nephritis.

His next step was to operate primarily for the cure of nephritis in cases where the kidney was not movable, by stripping off the capsule of the kidney instead of merely doing nephrotomy, as has been the practice of the European surgeons.

As to the *modus operandi* by which renal decapsulation exerts a favorable influence on chronic Bright's disease, Edebohls believes that by removing the impervious capsule of the kidney an opportunity is created for the formation of new vascular connections between the blood-vessels supplying the secreting structures of the kidney, on one hand, and the blood-vessels surrounding the kidney, on the other.

Edebohls made his first observations on 3 cases that had been operated on for nephropexy. He noted that the strong connective-tissue adhesions, or bands, attaching the kidney to its surroundings, contained large and numerous blood-vessels running between the kidney and its adjacent tissues.

The newly formed arteries predominated in size over the veins, and in all the arteries the direction of the blood-stream was *toward* the kidneys.

Edebohls believes that the increased blood-supply leads to an absorption of the interstitial or intertubular exudates, freeing the tubules from compression and promoting a re-establishment of the normal cir-

culation, with regeneration of epithelium capable of carrying on the secreting function.

The views of pathologists are strongly opposed to these explanations.

Van Cott and Murray,[12] in their experiments on dogs in the Hoagland Laboratory, found that after stripping the capsule a new, thick capsule was formed, with capillary and not arterial anastomoses. They also state that the elaborate researches of Marchand, Barth, and others prove undoubtedly that where extensive destruction of the renal tissue occurs repair is imperfect, and never to the degree of a restoration of functional activity.

Johnson[13] also found, in his experiments on dogs, that the new capsule which formed was thicker than the original one, and without anastomoses between the renal and perirenal vessels.

It is thus evident that clinicians and laboratory workers are at variance in explaining the anatomical basis of improvement after decapsulation.

Pel, Jaboulay, and others have suggested that the improvement comes more from the reaction of the operation upon the sympathetic ganglia, rather than from the increased blood-supply to the part.

The first beneficial effects of the operation do not appear before the tenth day, and are explained by Edebohls as probably due to the manipulation of the kidney during the operation, which acts as massage and stimulates its natural blood-supply.

He also states that the new capsule forms in from three weeks to three months after stripping; that it is sometimes thicker and sometimes thinner, but always more succulent and vascular than the original.

The *classification* of chronic Bright's disease varies greatly with different authorities, and is more confused by the fact that different pathological lesions always exist at the same time and in the same kidney.

Edebohls classifies as *interstitial nephritis* those cases in which inflammation of the connective tissue predominates; *parenchymatous nephritis,* in which involvement of the secreting apparatus forms the salient feature, and as *diffuse nephritis,* in which both parenchyma and connective tissue are equally involved.

The knowledge that a unilateral chronic nephritis can exist is a fact which has been unknown until very recently. Out of 72 cases of chronic Bright's disease operated upon, Edebohls found that in 11 cases one kidney alone was affected.

Unilateral disease of the kidney was found to exist more frequently among the milder and less advanced cases, for as the disease

progresses the other kidney becomes involved as well, so that Guiteras[10 15] found, in looking over the autopsy reports in 500 cases of chronic Bright's disease, that in not one instance could it be said that the nephritis was unilateral.

The length of time elapsing before the involvement of the second kidney probably explains the chronic course of a great many cases of Bright's disease in which the general health suffers but very little. The healthy kidney does the eliminative work for both organs, and uremia does not occur until the second kidney becomes badly disorganized.

As to the **indications for renal decapsulation,** Edebohls regards as suitable any patient with chronic Bright's disease who has a reasonable expectation of not less than a month of life without operation and who can stand the administration of an anesthetic. As the beneficial results of the operation do not appear for ten days, the above proviso is made.

In itself, the operation of renal decapsulation is one in which the danger to life is very slight, if undertaken before cardiac and vascular changes have occurred.

This is shown by Edebohls in his results in cases of nephropexy. He decapsulated and anchored both kidneys in 73 cases, with only one death.

Among the **contraindications** which bar out operation may be considered, first, dilatation of the heart, which predominates over hypertrophy, accompanied by *insufficiency of the aortic valves,* with an intermittent aortic regurgitant murmur with every third or fourth beat..

In such a case there is danger of death from a general anesthetic.

A certain degree of cardiac hypertrophy and degeneration goes with every case of chronic Bright's disease, but does not, in itself, constitute a contraindication.

Indeed, in several of Edebohls's cases cardiac hypertrophy disappeared after decapsulation.

When, however, the cardiac and the vascular changes have very extensively advanced, the dangers of the operation are so greatly increased that it is not worth the patient's while to take the risk.

When *retinitis albuminurica* is present, it shows that extensive vascular changes have taken place through the body, which in themselves will prove fatal in a short time, even though the kidney function be restored.

In 67 per cent. of the cases the patients will die in a year, while of the remainder none will survive over the second year.

Guiteras also looks unfavorably upon patients who are suffering from general anasarca with a bad heart, for statistics show that 50 per cent. die after operation, 25 per cent. are improved and finally die, and only 25 per cent. are improved or cured.

Chronic diffuse nephritis is the most unfavorable form of operation, as 75 per cent. of these die.

Many of them were suffering from general anasarca; nearly all were uremic, and most of them edematous.

TECHNIQUE OF OPERATION.

It is always advisable for the patient to rest in bed for a week before the operation, as the heart is usually diseased in cases of chronic Bright's disease, and, favoring the organ, improves its condition. Rest in bed also lessens the amount of waste material for the kidneys to excrete, and the time can be utilized for the chemical and microscopic examinations of the urine, for regulation of the food and drink, for administering urotropin, and cardiac and vascular regulators, like strychnine, digitalis, nitroglycerin, etc.

The proper preliminary preparation of a patient adds materially to the chances of a successful result.

In the less advanced cases catheterization of the ureters, or segregation of the urine, should always be employed, to determine if the disease is unilateral or not.

The operation of *excision of the renal capsule* is performed as follows:—

The patient lies prone on the table, with Edebohls's kidney air-cushion underlying and supporting the abdomen. Both kidneys are thus rendered accessible, without changing the position of the patient.

The incision is made from the twelfth rib to the crest of the ilium, along the outer margin of the erector spinæ, without opening the sheath of the muscle. The perirenal fat is exposed and separated from the kidney. The kidney is then lifted out of its fatty bed and delivered through the wound.

The capsule proper is then divided in a direction around the entire convex border of the kidney, each half of the capsule is stripped from the kidney and reflected toward the pelvis, until the surface of the kidney is raw and denuded.

The stripped-off capsule is next cut away and entirely removed. The kidney is then dropped back into its fatty bed, and the incision is closed without drainage. If the kidney was movable before the operation, it should be anchored with sutures to the muscles of the back; but this procedure is only necessary when it was movable.

For an anesthetic, Edebohls uses ether, preceded by nitrous oxide; and in cases where the Bright's disease is far advanced, he suggests the use of spinal anesthesia with cocaine.

RESULTS OF OPERATION.

Guiteras[15] collected statistics of 150 cases operated upon by various surgeons. He found, of these, 16 per cent. were cured, 40 per cent. improved, 11 per cent. unimproved, and 33 per cent. died.

In cases of interstitial nephritis, Guiteras states that the results often appear brilliant, as the albumin and casts disappear from the urine, but the amount of solids excreted remains the same.

The mortality in chronic interstitial nephritis was 26 per cent., in chronic parenchymatous, 25 per cent., and in chronic diffuse, 75 per cent.

Death was occasioned by the following causes: exhaustion, uremia, coma, edema of the lungs, acute dilatation of the heart, asthenia, apoplexy, and exacerbation of chronic nephritis.

Edebohls[16 17] sums up the results in 72 cases which he operated upon within the past twelve years as follows: 68 operations on both kidneys, and 4 operations on one kidney only. Seven patients died within two weeks following operation, 13 died ultimately of chronic nephritis or its complications, and 9 died of causes other than nephritis. Three patients were unimproved; 20 are in various stages of satisfactory improvement and progress toward health, at periods varying from two months to twelve months after operation. The urine of several of these is free from albumin and casts.

Seventeen patients were cured of chronic Bright's disease, and remained cured at periods after operation varying from one year and nine months to twelve years.

Three patients disappeared and could not be traced.

Since Edebohl's first publications the operation has been tried out by various surgeons pretty thoroughly and has been almost abandoned. It has, however, a limited field of usefulness, which is well summarized by Lehman[18] as follows:—

Indications for Renal Decapsulation.—Lehman concludes that Edebohls's operation is built up on false premises which are not confirmed in practice and that in consequence it should be rejected outright. This, however, refers only to the operative cure of chronic nephritis. In itself it is justifiable because under certain circumstances it can prolong the life of a nephritic, even although there is no essential curative element in it. Further, decapsulation has an indi-

cation in so-called nephralgias and nephrorrhagias of angioneurotic origin. It is an emergency life-saving procedure in extreme oliguria, especially in the uremia of acute nephritis. It also facilitates permanent recovery from the latter, and perhaps may actually contribute to it in some cases. In the uremia of chronic nephritis the operation is only justifiable if an acute exacerbation has occurred, the kidneys being still able to function. In purulent nephritis decapsulation may sometimes be conjoined with nephrotomy to favor drainage.

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DISEASES OF THE TESTICLES.

CHAPTER XVII.

ECTOPY OF THE TESTICLE.

THE testicles are developed in the abdominal cavity of the fetus. About the fifth month of fetal life they begin to descend, and pass through the inguinal canal into the scrotum, arriving there about a month before birth. One or both testicles may fail to follow the normal course, and may be retained:—

(*a*) In the abdomen (cryptorchism).

(*b*) In the inguinal canal.

(*c*) The testis may take an aberrant course and may be found lodged under the skin of the abdominal wall, the thigh, or perineum.

ETIOLOGY.

The causes which operate to prevent the normal descent of the testis are obscure. It may be accounted for, however, by assuming that the external inguinal ring is of too small a size to allow the testicle to pass through it, or that the vessels accompanying the spermatic cord are too short to allow the cord itself to be stretched sufficiently to allow the testis to reach the bottom of the scrotum. If the testicle is held by a long mesorchium in the abdominal cavity its mobility may be so great that it slips past the opening of the inguinal canal without entering it.

The wearing of a truss, on account of a hernia, in a case where the descent of the testicle has been delayed after birth, will also prevent the testis from arriving at its normal place in the scrotum.

The causes of crurofemoral and perineal ectopy are still more obscure. It is thought, however, that an overdevelopment of certain bands of the gubernaculum will have the effect of drawing the testis to one side and thus occasioning its aberrant course.

RESULTS.

The results of ectopy are impairment of the growth and development of the testis, so that it remains undersized, but probably possesses the power of forming spermatozoa, unless its structure is destroyed by attacks of inflammation, which are very liable to occur. After the testicle has been disorganized *sterility*, of course, follows.

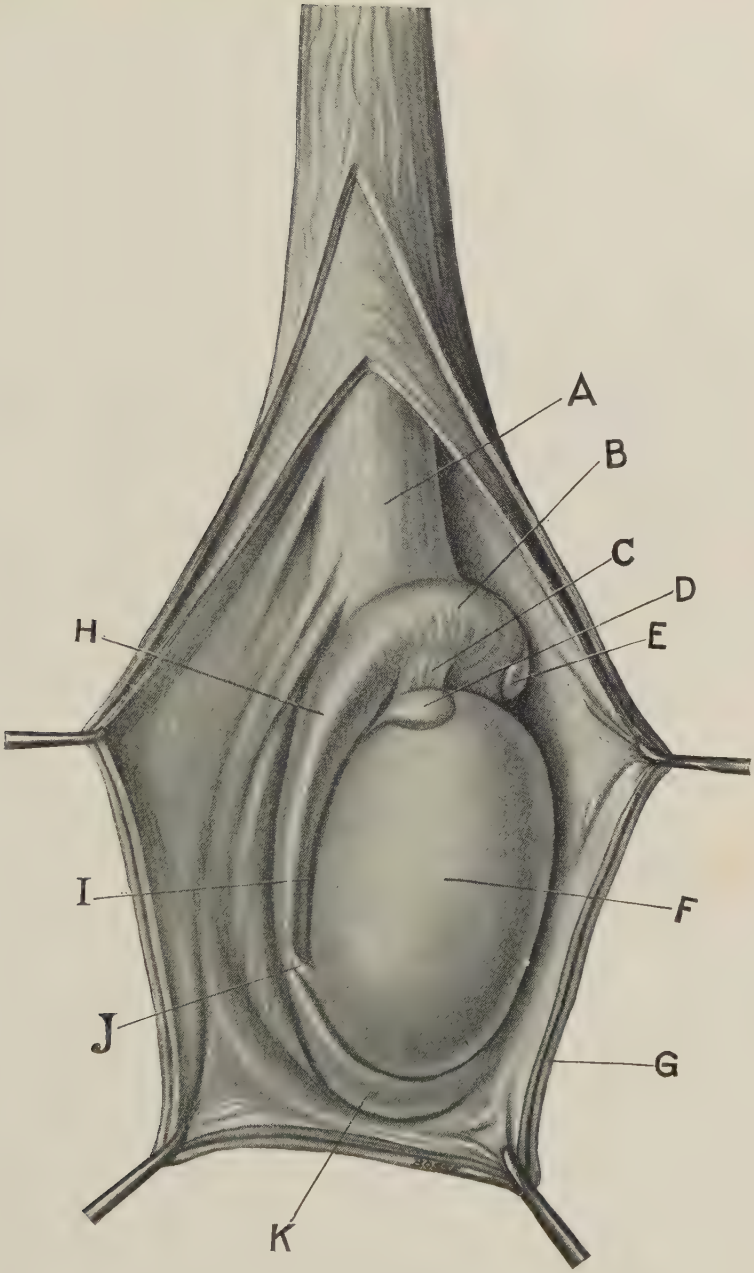


Fig. 233.—Testicle and its coverings. *A*, spermatic cord; *B*, globus major; *C*, superior ligament of epididymis; *D*, appendix testis; *E*, hydatid; *F*, testis; *G*, tunica vaginalis; *H*, epididymis; *I*, sinus epididymis; *J*, inferior ligament of epididymis; *K*, globus minor.

COMPLICATIONS.

Hernia is a very frequent accompaniment, and if the testicle lies in the inguinal canal it interferes with the wearing of a truss, so that strangulation of the hernia is very liable to occur.

The testicle when not lying protected by the thighs, in the scrotum, is very liable to be struck and bruised, and the ectopic testicle rarely escapes several attacks of traumatic inflammation.

It is also subject to gonorrheal inflammation from extension of a gonorrhea from the posterior urethra.

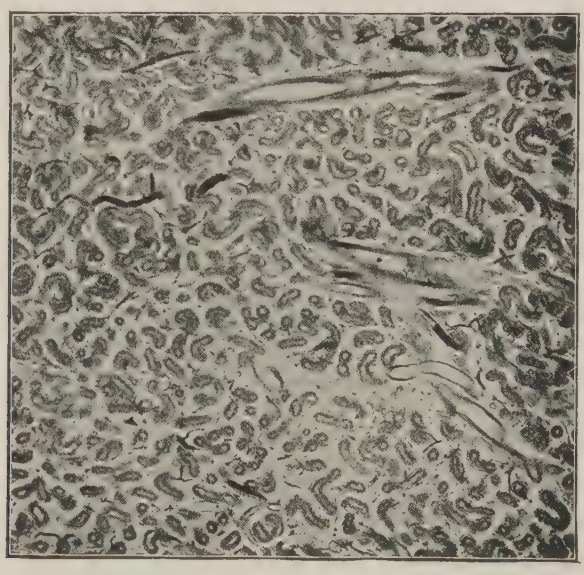


Fig. 234.—Normal testis.

Malignant disease is very apt to occur in the ectopic testicle, and is predisposed to by the attacks of inflammation to which the testicle in this situation is so liable.

DIAGNOSIS.

The diagnosis is made by (*a*) the absence of the testicle from the scrotum; (*b*) the detection of a smooth, oval, soft tumor in the inguinal canal, which moves up and down when the patient coughs and strains.

The testicle should not be mistaken for a hernia, which often complicates this condition.

TREATMENT.

In *intra-abdominal ectopy* or cryptorchism, it is impossible to rectify the condition by operation, as the spermatic cord is too short to admit of placing the testis in the scrotum.

In addition, as the testicle is protected from traumatism, inflammation does not occur in it, and the dangers of destruction of its function, with consequent sterility or malignant degeneration, do not occur, and the chief reasons for operation do not exist.

In *inguinal retention* it is often possible by means of gentle manipulation to push the testicle into its proper place in the scrotum, and it may be retained in position by wearing a proper truss, which closes the ring and prevents its return.

If this procedure fails to retain the testicle in place, and the child is over six years of age, a surgical operation should be performed, for the reason that the testicle does not reach its full size and functional development while in an abnormal situation. From its exposed location it is also constantly liable to blows and injuries. These lead to repeated attacks of inflammation, causing sterility, and also predispose to malignant disease. A simple and effective operation for replacing the testicle in position in the scrotum and retaining it there consists in making an incision through the scrotum and exposing the testicle, and dividing the fibers of the cremaster muscle. After the muscular fibers have been cut the testicle can be replaced at the bottom of the scrotum and kept from drawing up again into the inguinal canal by a catgut suture passed through the lowest part of the testicle and skin at the bottom of the scrotum. This serves to anchor testicle and hold it in place.

It is often necessary to bore a cavity in the cellular tissue of the scrotum, with the finger as a bed to receive and hold the replaced testicle. The wound is then closed.

In the author's hands this operation has proved successful and offered permanent relief.

In exceptional cases a different plan may have to be followed. The operation devised by Bevan is at present often employed. The *technique of Bevan's operation* as described by him is as follows:—

An incision is made three inches long over the inguinal canal and through the aponeurosis of the external oblique. Under the external oblique will be found a pouch of peritoneum extending from the abdominal peritoneum through the canal and down to the scrotum. This pouch of peritoneum is covered by the cremasteric muscle and fascia and the transversalis fascia. These three layers are divided and the peritoneal pouch opened. The vaginal process of peritoneum should be divided transversely well above the testicle. Care should be taken not to injure the cord, and in children, where the peritoneal process is as delicate as tissue paper, the dissection must be made with great care and with small instruments. After complete transverse division of the vaginal process the upper end is closed with a catgut ligature, as in the

sac in a hernia operation, and the lower end is closed with a purse-string suture, making a tunica vaginalis for the testis. Then, with a gauze sponge, the peritoneum is carefully wiped off from the cord. As the wiping proceeds, the cord will gradually lengthen until the testicle can be brought well down upon the thigh. Tense fibrous strands in the cord are to be torn either with the fingers or blunt dissecting forceps, and the cord is to be freed from everything except the vas and vessels. When, as in the exceptional case, a large peritoneal pouch extends to the bottom of the scrotum, the testicle can now be pushed into this and retained by a purse-string suture within the neck of the scrotum. As a rule, however, it is necessary to make a cavity by blunt dissection with the fingers.

In a few cases, but these are exceptional, it is found, even after the free exposure of the cord, that it is not long enough to permit of the reduction well into the scrotum. In such cases it will be seen that the shortened structures are the spermatic artery and veins. These can be divided between two ligatures, care being taken to avoid injury to the vas and the vessels of the vas. It will then be found that the testicle can by gentle traction be brought down sufficiently to replace it in the scrotum without tension. It will be found that the artery of the vas and the veins of the vas are quite sufficient to supply the entire testicle after the ligation of the spermatic artery and anterior group of veins. This statement of Bevan's apropos of the blood-supply has been borne out by Moschcowitz in a series of some 20 cases.

The wound is then closed as in an ordinary hernia operation, not transplanting the cord as is done in the Bassini operation, but allowing it to remain in its normal position.

The selection of this operation will depend upon the history of the case.

An operation to replace the testicle in the scrotum is only advisable *before* the occurrence of attacks of inflammation. After attacks of inflammation have occurred, the secreting structure of the testicle is destroyed, and the organ is rendered useless and only liable to disease. On this account *castration* is indicated, and at the same time the inguinal canal may be examined, and, if hernia is also present, it may be radically cured and the canal closed.

MALIGNANT DISEASE OF THE TESTICLE.

It is difficult to draw a distinction between benign and malignant growths of the testicle, because histologically the tumors are nearly always mixed formations composed of fibrous, myxomatous, sarcoma-

tous, and cartilaginous elements associated together, and tumors of the testicle which are apparently innocent are often followed by secondary deposits in the adjacent lymphatic glands and other organs.

VARIETIES AND CLASSIFICATION.

Sarcoma may be composed of spindle or round cells, or may, in its early stages, appear as numerous small cysts, filled with clear or dark fluid, scattered through the substance of the gland.

Carcinoma is usually of the soft, or encephaloid, variety.

Lymphadenoma, chondroma, fibroma, myxoma, and osteoma are also occasionally met with.

The clinical history of sarcoma and carcinoma, which are by far the most common forms, may be considered together.

The *age* at which the disease usually appears is from 15 to 45 years, but sarcoma is occasionally found in very young children.

The disease begins in the glandular epithelium of the tubes or in the connective tissue between the tubes, and increases in size, involving the whole of the body of the testicle.

The tumor formed is smooth and uniform, until the tunica albuginea breaks down, and after this occurs the growth feels irregular or nodular, with areas which are soft and fluctuating. The tumor increases more rapidly in size after rupture of the tunica albuginea and often becomes enormous. The skin of the scrotum sloughs and allows part of the testicle and granulations to protrude through the opening, forming *fungus testis.*

The spermatic cord enlarges from the infiltration of its tissues by the new growth, and the adjacent lymphatic glands become infected and enlarged.

The veins of the scrotum swell, and the lower extremities become edematous from the pressure of the pelvic and lumbar glands upon the iliac veins.

The general health fails, the patient becomes cachectic and emaciated, and death results in one or two years after the first appearance of the growth.

PROGNOSIS AND TREATMENT.

The great majority of tumors of the testicle are either malignant, tubercular or syphilitic, and it is always desirable to try the effect of inunctions of mercury and large doses of iodide of potassium, for ten days, if there is any suspicion of syphilis, or have a Wassermann test made. If there is no improvement at the end of that time, *castration* should at once be performed.

If this is done early enough, the disease may be permanently cured, but unfortunately it is not uncommon for the lymphatic glands in the pelvis to be involved, and a recurrence of the disease often takes place within a year after the operation.

TUBERCULOSIS OF THE TESTICLE.

The testicle is frequently the seat of tuberculosis, which always begins in the epididymis and may subsequently involve the body of the testicle.

The epididymis may be affected (*a*) primarily, which is most frequent; (*b*) secondarily from a tubercular deposit in one of the other genitourinary organs, or (*c*) in consequence of a general tuberculosis.

CHANNELS THROUGH WHICH TUBERCLE BACILLI ARE CONVEYED TO THE EPIDIDYMIS.

When the epididymis is affected primarily, the bacilli are introduced into the general blood-circulation and carried directly to the epididymis by the spermatic artery.

When the infection in the epididymis is secondary it is frequently derived from the seminal vesicles. These are often affected by tuberculosis, as the result of tubercle bacilli which were introduced into the urethra during coitus.

After the tubercular process is established in the vesicles, the bacilli are carried along the vas deferens and lodge in the epididymis.

If the tuberculosis in the epididymis is derived from the bladder, prostate, or other adjacent organs, the infection is usually carried by means of the lymphatics.

There are certain *predisposing causes* to tubercular infection, such as a hereditary tendency to consumption and such local causes as the prolonged congestion from erotic excitement, an attack of gonorrhea, or slight traumatism. These causes all probably operate in the same way, by lowering the resistance of the tissues and permitting the tubercle bacilli to take effect.

The time of life at which the testicle is most likely to be attacked is during its period of activity, from the age of puberty until past the fiftieth year.

COURSE.

One or two small nodules form in the head of the epididymis. Occasionally they remain latent for years or may become encapsulated and converted into fibrous tissue. As a rule, however, the nodules grow and coalesce until the whole epididymis is so much enlarged that it

surrounds the testicle. After a time the tubercular mass softens, becomes cheesy, and breaks down.

The skin of the scrotum lying over the nodules is attached to the testicle, glued fast by the inflammatory adhesions, and the pus is discharged through an opening in it from the tubercular abscess, leaving a fistula.

The disease seldom limits itself to the epididymis, but if left alone

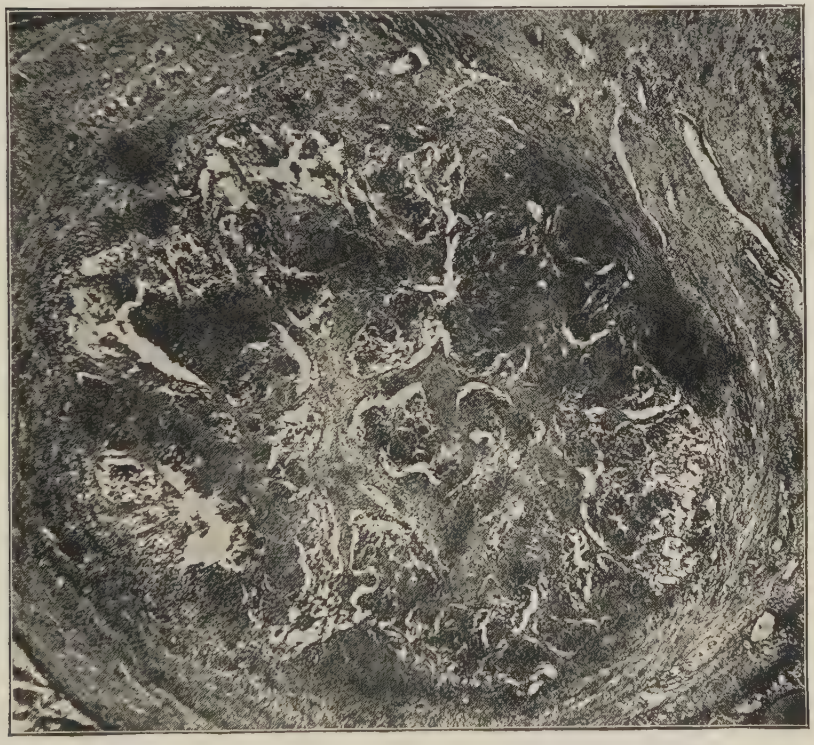


Fig. 235.—Tuberculous epididymitis; cheesy nodules.

spreads to the testicle. This occurs in three-fourths of the cases, as shown by autopsy.

After the abscess in the epididymis or testicle has opened, a considerable amount of attached skin lying over the nodule may slough away, leaving an opening in the scrotum through which a mass of new granulation tissue, growing from the testicle or tunica albuginea, may protrude, forming *hernia testis,* or *fungus testis.*

In the earlier stages of the disease, before abscess formation, the *tunica vaginalis* is affected by the inflammation, and, if an excess of fluid is secreted by its walls, hydrocele may be present.

On the other hand, adhesive inflammation may take place, and the sac of the tunica vaginalis become obliterated.

Occasionally purulent collections containing tubercle bacilli are found in small cavities, circumscribed by the adhesions.

The *vas deferens* is always affected in time, and shows small localized nodules in its continuity, which are most liable to be located at its extremities,—*i.e.*, near the seminal vesicle and the epididymis,—the intermediate portion being free.

Fig. 236.—Hernia or fungus testis.

More rarely the cord is uniformly thickened, with a general diffuse tubercular infiltration.

The other testicle in time becomes affected, and the disease runs its usual course.

Although tuberculosis of the testicle usually runs a very slow and insidious course, the nodules developing gradually until the formation of pus, rare cases are occasionally met with in which the disease runs a very acute course, called by Réclus **galloping consumption of the testicle.**

The nodules which had existed quietly for a time from some cause take on a very rapid growth, and caseation and abscess formation occur in about three weeks. In this form the testicle itself is always attacked,

and it is usually accompanied by a purulent urethral discharge containing tubercle bacilli. The discharge may originate spontaneously or it may begin as a gonorrhea from infection with gonococci during coitus.

SYMPTOMS AND DIAGNOSIS.

Tubercular nodules may exist in the epididymis—remain latent for months—without causing any discomfort, and, if discovered, they are usually found accidentally.

Discomfort does not occur until inflammation begins, with its pain, swelling, and subsequent abscess formation.

In the early stages examination shows one or more small nodules of a peculiar stony hardness to touch, located in the head of the epididymis and along the cord.

Later in the disease, after the nodules have become cheesy or broken down, the skin is found to be adherent over a circumscribed tumor, with hard walls and a central softening, which may yield fluctuation if pus is present.

Although the nodule may be actually located in the epididymis, the enlargement of this part of the organ is so great that it may surround the body of the testicle, giving rise to an appearance as though the nodule were in the testicle itself.

Suspicions as to the tubercular nature of a growth should always be aroused by the history of an epididymitis coming on without any apparent cause or after a slight injury, and in perhaps half of the cases of tubercular epididymitis an examination of the prostate and seminal vesicles through the rectum will disclose the characteristic small, hard nodules which verify the diagnosis.

If the accompanying hydrocele is considerable in size the fluid should be drawn off, so that the outline of the testicle may be more clearly felt on palpation, and occasionally, though not often, tubercle bacilli may be found on microscopic examination of the aspirated fluid. The tests for the tuberculin reaction may be employed in making the differential diagnosis. The von Pirquet test is simpler to use, but, as nearly every adult has a focus of healed tuberculosis in his body, a positive reaction is not an absolute proof. The subcutaneous injection of old tuberculin with its accompanying temperature rise in the presence of an active focus of tuberculosis is more reliable.

Under treatment the severe inflammatory symptoms of epididymitis quickly subside, and are usually followed by a general softening of the tumor and formation of abscess, differing in this way from a simple epididymitis, which, after it is over, leaves a hard and thickened epididymis.

PROGNOSIS.

It is a very rare occurrence for tuberculosis of the testicle to become permanently cured without operation, even under the most favorable climatic influences.

When a cure does occur, it is through a process of encapsulation and fibroid degeneration, but it often happens that the process of encapsulation only closes up the infective material for a time, and under favoring conditions the deposit again becomes active and continues its usual course of caseation, abscess formation, and infection of remote organs.

Tubercular nodules, however, may remain latent for many years before abscess forms, or until a slight traumatism or attack of gonorrhea stirs them into activity.

After suppuration the disease runs a rapid course, and leads to a fatal termination, either by inducing tuberculosis in some other organ or by the exhaustion and fever incident to the occurrence of suppurating fistulæ.

TREATMENT.

Palliative measures are, unfortunately, only applicable to people of means, who are able to lead an out-of-door life or take a long sea-voyage, and who can have constant medical supervision. Such measures may retard the caseation of the nodules if begun in the earliest stage while the deposits are small and hard.

As soon as the deposits begin to soften and become cheesy, surgical measures should at once be resorted to, as waiting for resolution, which never occurs, is only a waste of valuable time, and allows the extension of the disease to remote organs.

In the case of hospital patients who are poorly nourished and badly housed, and who cannot have suitable climatic surroundings, the nodules should be removed at once.

OPERATIVE TREATMENT.

Erasion, or **curetting,** is the operation which is sometimes advised in the cases where one or two small nodules exist in the epididymis. The softened area should be opened and the contents well scraped out with a sharp spoon, iodoform rubbed in, and the cavity packed and allowed to heal by granulation.

Erasion has never been very extensively employed, on account of the fact that tuberculous nodules so small as not to be recognized are generally present in the body of the testicle and relapses are pretty sure to occur.

Where only one or two distinct nodules are felt in the epididymis and the testicle appears healthy, **epididymectomy** is the operation advised at the present time. The testicle and epididymis are exposed by incision through the scrotum; the epididymis with the tuberculous nodules is dissected away from the testicle and extirpated, and the severed end of the vas deferens is sewed into the wound, so that any tuberculous material in its peripheral part and the seminal vesicle has an exit and is not discharged in the wound. Rovsing reports 27 cases treated in this way with good results.[1]

Castration is the operation best adapted to the advanced cases. The indications for its use have been summarized by Jacobson as follows:—

(*a*) When erasion has failed in lesions of the epididymis.

(*b*) When discharging fistulæ are present or are numerous.

(*c*) When, after erasion, persistent swelling of the testicle accompanied with night-sweats and loss of flesh is present.

(*d*) When fungus testis exists or when the body of the testicle is involved.

(*e*) In the presence of purulent hydrocele.

Castration is used in two different classes of cases:—

Class A.—In *primary* tuberculosis, when the disease is limited to one testicle and has not extended too high along the cord, and when the bladder, prostate, and vesicles are not affected. In such a case a reasonable hope may be entertained that the disease may be permanently eradicated from the body. If the seminal vesicles are affected the indication for castration is not so clear, although, if the deposits are small and of recent date and the patient's general condition favors rapid healing, removing the testicle with its diseased nodules may retard the development of the tubercular foci located elsewhere.

Class B.—In cases where other organs of the body are tubercular and a cure is impossible, hygienic measures alone are the only treatment applicable. An exception should be made to this rule when the testicle is disorganized and the scrotum riddled with sinuses discharging pus. Here castration is indicated to relieve the patient from the drain of the exhausting discharges and from one source of his discomfort.

In the operation of castration the infiltrated skin and the cellular tissue should be removed, and if nodules are found in the spermatic cord it should be divided as high up as possible by burning the vas deferens through with the Paquelin cautery and ligating the vein and artery.

If the cord is not infiltrated it is better to separate the vas deferens

[1] Zeitschrift für Urologie, Band 3, Heft 4.

from the vessels and bring the end out of the wound as described in the operation of epididymectomy.

After every surgical procedure it is essential for the patient in order to prevent recurrences to live an out-of-door life and remember that he is still a tuberculous subject.

SYPHILIS OF THE TESTICLE.

The testicle is attacked by syphilis in the late secondary and tertiary periods, which presents itself in **two forms:—**

(*a*) **Interstitial or diffuse form** consists in an infiltration of the connective tissue between the tubules, which becomes converted into a hard, fibrous induration, compressing and destroying the tubules, and an atrophy of the entire organ results.

(*b*) **Circumscribed or gummatous form** is a deposit of gummatous nodules varying in size from a pinhead to a hen's egg. After they have enlarged to a considerable size the mechanical compression of the cortex causes a cheesy degeneration of the substance and a contraction of the nodule, or the center becomes softened and is discharged through an ulcerated opening in the skin of the scrotum.

The epididymis may be involved secondarily in both forms, and hydrocele usually occurs from an effusion of fluid into the sac of the tunica vaginalis.

SYMPTOMS AND COURSE.

The body of the testicle enlarges slowly and insidiously, without causing any pain, and it often becomes as large as an orange.

In *shape* its outline is regular, although the protuberance of a circumscribed gumma may sometimes be felt. Its consistence is dense, and it feels heavy. The spermatic cord, as a rule, is not thickened.

The scrotum is not affected until after the gumma breaks down, wher it becomes adherent, inflames, and ulcerates, and *fungus testis* forms.

The disease is seldom bilateral at the beginning, but the other testicle may be attacked later.

Sterility only results from advanced disease in both organs, as a part of the secreting substance of the gland is spared.

DIAGNOSIS.

Syphilitic testicle is liable to be mistaken for tuberculosis, neoplasms, gonorrheal epididymitis, or hematocele.

The distinguishing points in syphilis are the regular outline and smooth, hard surface and the fact that the cord is not enlarged, and in

addition the history of a past attack of syphilis and a positive Wassermann reaction.

The diagnosis may be confirmed by the effects of antisyphilitic treatment, and this should be tried in every case of tumor of the testicle before proceeding to operation, if there is the slightest question of a previous syphilitic infection.

PROGNOSIS.

Under appropriate treatment syphilitic infiltration is absorbed, and it is surprising to note how quickly large swellings disappear and the function of the testicle is restored.

In untreated persons—particularly in tubercular, alcoholic, and weakly individuals—the gummata break down and discharge and hernia testis follows, but even neglected cases which present ulceration of the scrotum and large fungus testis generally heal in from four to six weeks under antisyphilitic treatment.

TREATMENT.

The treatment consists in a general course of mercurial inunctions and the internal administration of iodide of potassium in increasing doses, running it up to ½ ounce per day, if necessary, to cause absorption of the newly formed tissue.

HYDROCELE, HEMATOCELE, AND VARICOCELE.

CHAPTER XVIII.

HYDROCELE.

Before the testicle descends from the abdominal cavity in the fetus, it is preceded by a process of peritoneum, which makes its way through the inguinal canal and forms a pouch in the scrotum called the *tunica vaginalis testis*. After the testicle has descended it lies *behind* the pouch, and is adherent to it.

Under ordinary conditions the opening in the pouch which formerly communicated with the abdominal cavity is closed. If it remains open, *congenital hydrocele* is said to exist. If the opening closes, the testicle is provided with a shut sac, lying in front of it and partly surrounding it, which serves as a protection against injuries, and allows of a certain freedom of motion.

ACUTE HYDROCELE.

ETIOLOGY.

Acute hydrocele is usually the result of a contusion of the testicle or a punctured wound of the sac of the tunica vaginalis. It may also occur from an extension of inflammation from the epididymis or testicle, occurring in the course of gonorrhea or other infectious disease.

PATHOLOGY.

Its pathology consists in an accumulation of serous fluid, which is occasionally stained with blood in the sac, and a deposit of lymph upon its walls.

SYMPTOMS.

The symptoms consist in edema and redness of the scrotum, accompanied by an elastic painful swelling, which is tender on pressure over the testicle.

If much fibrin is deposited, crepitation is sometimes observed. Acute hydrocele *terminates* either (*a*) in recovery in two or three weeks,

with the formation of adhesions within the sac and a thickening of its walls; (*b*) in suppuration or (*c*) it may become chronic.

TREATMENT.

The treatment consists in rest, with suspension of the scrotum and the local use of an ice-bag or hot application. After the acute

Fig. 237.—Hydrocele. (Author's case, from Kings County Hospital.)

symptoms have subsided the patient can walk about, wearing a suspensory bandage. If much fluid is present in the sac and tension is extreme, aspiration is required.

ACUTE PURULENT HYDROCELE.

It occasionally happens that a fibroserous hydrocele becomes purulent instead of resolving, or suppuration may occur early as a

result of an infected puncture of the sac, or an extension of a suppurative process from the testicle or epididymis.

In such a case the contents of the sac, instead of being clear serum, are composed of pus. Such a condition is apt to result in involvement of the peritoneum or a general septic infection, unless the pus is evacuated by a free incision and drainage.

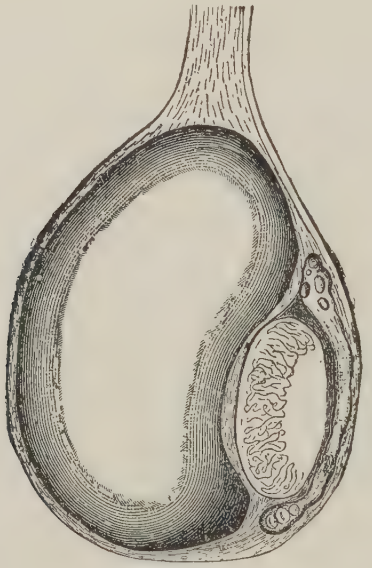


Fig. 238.—Vertical section of simple hydrocele.

CHRONIC HYDROCELE.

Chronic hydrocele is generally confined to one side, and ordinarily occurs between the twentieth and fortieth years, although children are occasionally born with it. It generally begins insidiously, although it may follow an acute attack.

It is supposed to be a mere passive process of transudation dependent upon the state of the blood-vessels and circulation, when it occurs as a primary disease.

PATHOLOGY.

The quantity of fluid which the sac contains is variable, from a few ounces to 1, 2, or even 3 quarts. Its color is usually clear and watery, but it may be greenish or bloody. It contains a large number of desquamated epithelial cells and leucocytes, it appears turbid, and blood gives it a reddish or brown color.

In rare cases the fluid is white, and resembles milk, from an admixture with lymph (hydrocele chylosa), and, in the tropics and in cases of true elephantiasis, filiaria are found in the milk-like contents of the sac.

In long-standing cases of chronic hydrocele the tunica vaginalis is thickened, and may be calcified in portions, and the testicle and epididymis are hard and atrophied.

Sometimes adhesions form, and the sac is converted into a number of distinct compartments. In other cases small fibrous or fibrocystic bodies are attached to the wall or lie loosely within the sac.

Fig. 239.—Hydrocele complicated by hernia.

SYMPTOMS AND DIAGNOSIS.

Hydrocele causes no symptoms except those which arise from the increase in size and weight of the scrotal enlargement.

On palpation, the tumor is found to be pear-shaped and elastic to the touch, dull on percussion, without impulse on coughing, and it cannot be reduced and returned into the abdomen.

Attention to these points will usually differentiate a hydrocele from a hernia, hematocele, neoplasm of the testicle, or a hydrocele of the cord.

An additional point in diagnosis is the *translucency* of the hydrocele when it is viewed through a tube with a candle placed on the other side of the scrotum.

Instead of using a candle, an electric hand-searchlight affords a convenient means of examining the hydrocele for the sign of translucency, and by moving the light over the surface of the tumor the outline of the testicle itself can often be made out.

This sign is not infallible, however, as the thickened walls of the sac or turbidity of its contents from pus or blood prevent the light from being transmitted.

As a last resource in diagnosis a suspected hydrocele may be aspirated with a fine needle, or the patient may be prepared for operation and the contents of the scrotum exposed by an incision.

TREATMENT.

The spontaneous healing of a hydrocele in an adult is such a rare occurrence that operation is always called for.

Puncture with a trocar may be regarded as palliative only, for the sac always fills up again with fluid in a short time.

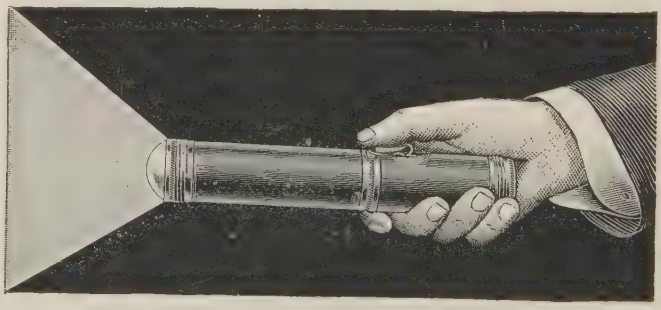


Fig. 240.—Electric hand-searchlight.

Technique.—The scrotum is grasped in the hand and made tense, and after locating the position of the testicle, which is usually a little below and lying behind the sac, the trocar, with its point directed obliquely upward and inward, is thrust into the swelling, and the fluid is withdrawn.

Radical Treatment by Injection.—This is successful in many cases of hydrocele of moderate size and where the walls of the sac are not thickened, although it is more liable to be followed by a relapse than after incision.

The advantages of injection are, that no anesthetic is required and the patient is only confined to the house three or four days.

Technique.—A hypodermic syringe is filled with 5 to 20 minims of pure carbolic acid, and the needle is introduced into the cavity of the sac. The hydrocele is then tapped with a trocar in the ordinary way, and the fluid is drawn off entirely. It is necessary that the sac should be completely emptied, for, if fluid is left in, the carbolic acid is diluted, so that it does not produce the necessary amount of irritation, and if diluted it may be absorbed and cause poisoning.

After the fluid is drawn off, the carbolic acid should be injected, through the hypodermic needle, which has remained *in situ,* and the carbolic acid is not withdrawn, but left in the sac. Inflammatory reaction is excited, but the exudate is gradually absorbed, and the sac becomes obliterated by the formation of adhesions between its visceral and parietal walls.

Incision of the sac is preferred to the treatment by injection in the following cases (Morris):—

I. When the sac is very thick, opaque, cartilaginous, or calcified.

Fig. 241.—Tapping a hydrocele.

II. If doubt exists as to whether the hydrocele is congenital or is a hydrocele of a hernial sac with a small opening into the peritoneum.

III. When a hernia complicates hydrocele and a radical cure of both is desired.

IV. When a loose or pedunculated fibrous body is present in the tunica vaginalis.

V. When organic disease of the testicle is suspected.

VI. When on account of ill health or lessened resistance the risk of inflammation after injection is especially to be dreaded.

There are three methods of performing the operation of incision:—

(*a*) *Volkmann's Operation of Simple Incision.*—In this procedure the sac is opened by a longitudinal incision through the scrotum, and after the fluid is evacuated the edges of the walls of the sac are stitched to the edges of the wound in the skin, to prevent leakage into the cellular tissue of the scrotum. The cavity of the sac is

packed and allowed to heal by granulation, and in this way the sac becomes obliterated. The patient is able to get out of bed in a week, and the wound is healed by about the third week.

(*b*) *Von Bergmann's Operation of Incision and Excision of the Tunica Vaginalis.*—Tillmanns considers this the best radical operation. The sac is laid bare by a longitudinal incision, and by blunt dissection is freed from the cellular tissue. The redundant portion of the sac is then cut away with scissors from the testicle, but leaving enough of the wall of the sac to cover the testicle itself. The external wound is closed with sutures, and a dressing applied which will exert compression. The wound is cicatrized in from eight to twelve days.

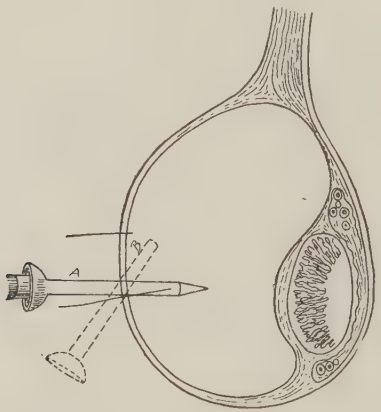


Fig. 242.—Tapping a hydrocele. *A*, direction of trocar at time of puncture; *B*, direction of trocar by evacuation.

Relapses are more certainly prevented through excision than by other methods, and the wound heals in a very short time.

(*c*) *Doyen's Operation of Incision and Excision of the Sac.*—An excellent operative procedure recently suggested by Doyen for thin-walled hydroceles consists in incising the sac and everting the testicle so that it lies outside the sac. The wound in the sac is then sutured to prevent the return of the hydrocele, and the incision in the scrotum is closed without drainage.

The operation of simple incision of the sac is attended by the disadvantage of the prolonged time of convalescence.

Excision of a portion of the sac is sometimes followed by hemorrhage, which is a free and continuous oozing from the cut edge of the sac, and which fills up the cavity in the scrotum, causing a hematuria. The oozing is best controlled by a running catgut suture around the edge of the sac at the time of the operation.

If the portion of the sac-wall which contains the nutrient artery is cut away, necrosis of the testicle follows.

Doyen's operation is especially adapted to thin-walled sacs, but may also be used in cases with thick walls, and these disadvantages can be thus obviated.

HYDROCELE OF THE SPERMATIC CORD.

(*a*) **The cystic form** is found as one or more small cysts, which form in the sheath of the cord, along its course between the testicle and the internal ring. The cysts are caused by an infusion of serous fluid into some part of the processus vaginalis, which was not obliterated after the descent of the testicle.

The cysts usually occur between the testicle and internal ring, and may extend so far down into the scrotum as to displace the testicle to one side; in a few cases the cyst lies within the inguinal canal.

Occasionally the cyst forming a hydrocele of the cord is not closed at either end, but communicates with the tunica vaginalis and also the peritoneal cavity (communicating hydrocele of the cord), and it is a frequent occurrence for the cyst to communicate with the sac of the tunica vaginalis testis. The cysts are shaped like an egg, and range in size from a pea to a hen's egg.

(*b*) **The diffuse form** of hydrocele of the cord is of extremely rare occurrence, and consists in an edematous infiltration of the entire sheath of the cord, ceasing abruptly at the testicle below. The chief importance of hydrocele of the cord is from a diagnostic standpoint: in differentiating it from cryptorchism or hernia.

TREATMENT.

The use of injections of carbolic acid is attended with some danger, as the cyst may communicate with the peritoneal cavity and the carbolic acid may flow back into the abdominal cavity.

Operation is usually called for, and consists in division of the common sheath of the cord, in a longitudinal direction, and exsection of as much of the sac as can be separated from the cord. If the sac is found to be open, communicating with the peritoneal cavity, it is necessary to close the inguinal canal by suturing the upper edge to Poupart's ligament, as in Bassini's operation for hernia. If this were not done, the omentum and gut would subsequently descend through the patulous inguinal canal, and cause hernia.

HEMATOCELE.

Hematocele is the name given to the tumor which forms when a hemorrhage occurs (*a*) into the sac of the tunica vaginalis (vaginal hematocele), or (*b*) into the scrotal tissues around the testicle (extravaginal hematocele), or (*c*) with the sheath of the spermatic cord (hematocele of the cord).

ETIOLOGY.

A *predisposing cause,* in the shape of disease of the walls of the tunica vaginalis or of the testicle, is very apt to be present.

The *exciting cause* of the hemorrhage is always traumatism, which may be slight, such as coughing, sneezing, or straining at stool,—or it may be severe and the result of a blow or kick upon the scrotum or the accidental puncture of the testis with a trocar in tapping a hydrocele.

SYMPTOMS AND COURSE.

Swelling of the scrotum takes place very quickly after the injury, and a tumor forms, which is a hard, smooth, globular swelling surrounding the testicle. After a few days inflammatory thickening of the tissues occurs, and the hematocele is liable to be mistaken for a neoplasm of the testicle.

The blood-clot may remain for years without being absorbed, in which case the walls of the tunica vaginalis become thick and dense, and the testicle undergoes atrophy. On the other hand, the clot may become infected, and suppuration occurs, ending in abscess.

TREATMENT.

In recent cases a moderate effusion of blood may be absorbed with the assistance of rest in bed, elevation of the scrotum, and 25 to 50 per cent. ointment of ichthyol; but spontaneous absorption is of seldom occurrence, and operation is usually necessary.

The operative treatment consists in laying open the sac by a free incision and evacuating the blood-clot. The sac of the tunica vaginalis may afterward be treated as a hydrocele, and either exsected or its cavity packed and allowed to granulate.

HEMATOCELE OF THE SPERMATIC CORD.

This is a rare affection, and may occur from direct violence or from the strain of lifting a heavy weight, even though the cord is perfectly healthy.

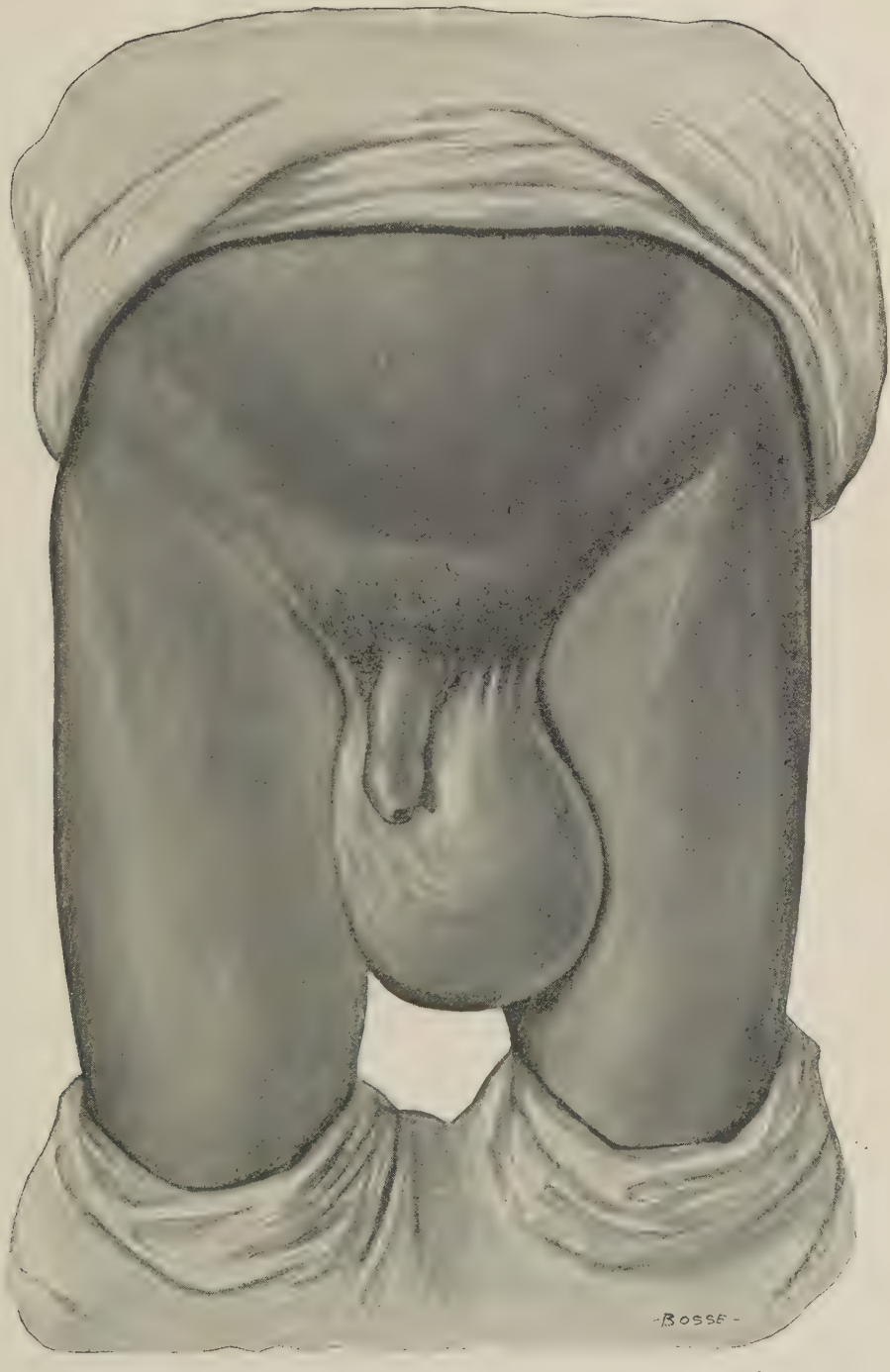


Fig. 243.—Chronic hydrocele complicated by hematocele from a fall. Author's case.

DIAGNOSIS.

The diagnosis of varicocele is usually easy, and the veins in the scrotum feel like a bunch of angle-worms. In very marked cases the enlarged blue veins can be seen shining through the skin of the scrotum. In cases of moderate severity the testicle is slightly flabby and the skin of the scrotum relaxed.

If the patient lies down, the swelling disappears, not suddenly, like a hernia, but more gradually and almost imperceptibly, and, if he stands upright again, pressure with the finger over the external ring does not prevent the veins from refilling with blood, whereas in hernia the omentum is prevented from descending by pressure over the ring.

TREATMENT.

Palliative treatment is all that is required in varicocele of moderate size and which causes but little discomfort. The scrotum should be supported with a well-fitting suspensory bandage, and, locally, cold douching is of service in giving tone to the muscles. Constipation should be prevented, and the patient should avoid erotic excitement or too frequent coitus.

Operation is required only in marked cases, when the support of a suspensory bandage is not sufficient to remove the annoyance of weight and dragging, after walking or long standing, or in cases where a considerable degree of enlargement of the veins exists. Operation is also called for in persons desiring to enter the army, navy, or police service, in which any degree of varicocele is regarded as a disability.

The operation of **subcutaneous ligation of the veins** is popular with some surgeons. It has the advantage that the time of convalescence is a little shortened, but its disadvantages are weighty. A vein is very liable to be punctured, and an hematocele occurs. The silk ligature remains permanently, becomes imbedded in scar-tissue, and sometimes causes persistent neuralgia, making it necessary to open up the wound and exsect the knot, or the knot may slip and the vein is not occluded. The danger of tying in the spermatic cord exists, but can be guarded against by due care in holding the cord out of the way.

Relapses occur with greater frequency after subcutaneous ligation than after excision.

Excision of a portion of the veins is the operation to be preferred, and the patient is only kept in bed for a week or ten days. By the open operation it is possible to avoid all the dangers attendant upon the subcutaneous ligation.

Technique.—The patient is etherized, and an incision made over the bunch of veins, beginning near the external inguinal ring and extending two inches down over the scrotum. The veins are exposed by dissection and ligated in two places, about an inch apart. The portion of the veins lying between the ligatures is then cut out with scissors, and the cut ends of each portion of the vein are brought together into apposition and held so, by tying the ends of the ligatures together, and in this way the vein is shortened. The wound is then closed by sutures.

The patient is kept in bed for a week, and on a sofa for another week, and after the third week is completed he can begin his active labors, and the same length of time should elapse after the subcutaneous ligation.

After either operation a hard mass remains in the scrotum, composed of coagula in the veins and infiltration around them. This is absorbed and disappears in from two to four months.

Atrophy of the testicle exceptionally follows either operation, even when the cord is not included in the ligature.

On account of the difficulty of securing a thoroughly sterile operation field, among the rugæ of the scrotum, the following plan for excising a varicocele, by which the incision is made above the pubes, is extensively used in the United States Army and elsewhere[1]:—

The pubes are shaved and the skin sterilized in the usual way.

The finger is introduced by the spermatic cord into the inguinal canal until the external ring is felt.

An incision is then made corresponding to the axis of the canal, one inch long, the upper end terminating over the external inguinal ring.

Superficial and deep fasciæ are divided over a director. The vessels of the cord then come into view. The finger is passed under the cord by a little blunt separation, and the cord is raised out of the wound. The spermatic cord and artery are returned to the bottom of the wound, to prevent accidental injury. A sound vein, selected for preservation to return the blood from the testicle, is carefully separated from the strand of veins and carried alongside the duct.

The veins are then dissected from the connective tissue for a distance of about two inches, ligated with small-sized catgut at the end of these dissections, and cut off between the ligatures.

The ends of the ligatures are then tied together, thus approximating the upper and lower ends of the veins. For further safety

[1] Circular No. 3 from Surgeon-general's office, February 27, 1901.

the ends are united by stitches, and finally anchored to the external pillars of the ring.

The deep and superficial fasciæ are then separately united with a continuous catgut suture, and the skin by a subcuticular suture of silkworm gut.

This method has been found very successful in preventing infection of the wound, either during the operation or subsequently.

DIAGNOSIS OF TUMORS IN THE SCROTUM.

Ordinarily the diagnosis of the nature of a tumor in the scrotum can be made without much difficulty. In a few cases, however, it is impossible to make a diagnosis until the scrotum is freely incised and laid open, and the tumor is fully exposed to view.

A methodic examination will facilitate arriving at a correct opinion, and the student may find the following schematic arrangement of use:—

We should endeavor to determine if the tumor in the scrotum is an

Enlargement of (*a*) **the testis or** (*b*) **the epididymis.**

Hernia.

Hematocele.

Varicocele.

Hydrocele (*a*) **of the tunica vaginalis;** (*b*) **of the spermatic cord.**

History.—Age of patient and general condition; family history of tuberculosis; any previous manifestations of tuberculosis in lungs, bones, joints, or genitourinary tract.

Length of time growth has existed, and if it grew slowly or came on suddenly, and if reducible.

Inquire as to pain, traumatism, gonorrhea, and syphilis. If treatment has been previously used, note the effects of tapping and inunctions of mercury and iodide of potassium in large doses.

Examination.—*Palpation.*—Observe if the body of the testicle is involved, or the epididymis; also the size, shape, and density of the tumor, particularly with reference to fluctuation, elasticity, or stony hardness. Note if the spermatic cord is enlarged or not, and if the tumor is reducible; if the inguinal ring is open and enlarged, and if an impulse is felt on coughing.

The condition of the scrotal veins should be examined with the patient standing upright, for a varicocele always disappears when the individual lies down.

The sign of **translucency** is obtained by examining the tumor with transmitted light.

In the presence of a solid tumor or hernia, the light is obscured; but in a simple hydrocele, with clear contents and thin walls, the light

passes through. If the walls of the sac are thickened, or if it is filled with blood or chylous contents from lymph, and in the tropics, filaria, the light is not transmitted, and the hydrocele appears opaque.

Puncture of the tumor with an aspirating needle never does harm, and often may clear up the diagnosis by demonstrating the presence and character of the fluid withdrawn, or the fact of its absence.

When, in spite of the methodic examination, doubt exists in the surgeon's mind as to the nature of the growth, the patient should be prepared for operation, etherized, and a free incision made over the tumor, which can then be dealt with as occasion requires.

CHANCROID AND ITS COMPLICATIONS.

CHAPTER XIX.

CHANCROID.

Synonyms.—Soft chancre, or simple venereal ulcer.

The etiology of chancroid was, until very recently, involved in obscurity. There were two views held as to its exciting cause.

Fig. 245.—Section of chancroid. *a*, small round-celled infiltration; *b*, lymphatics, open and gaping; *c*, blood-vessel. (From "Die Syphilis und die Venerischen Krankheiten," von *Dr. Ernest Finger.*)

One opinion (*a*) as to the causation of chancroid, which was generally accepted, was that chancroid is merely an active form of wound-infection and that it is caused by the inoculation under the skin of any of the pus-producing micro-organisms, and in this and other respects resembles, clinically, impetigo contagiosa or ecthyma.

The other view (*b*) is that chancroid is due to a particular micro-organism produced in another chancroid, and called, after its discoverer, the **Bacillus of Ducrey.** This was not universally ac-

cepted at first, but the experiments of Bezançon, Griffon, Le Sourd, and Lenglet, in making cultures and inoculations, have within the past six years decided the question definitely, and today Ducrey's bacillus is accepted as the pathognomonic organism of chancroid.

The experiments above mentioned were confirmed by Tomaszewski,[1] who inoculated two apes with chancroidal virus. These were followed by sores from which he made pure cultures, inoculated himself, and recovered the bacillus of Ducrey.

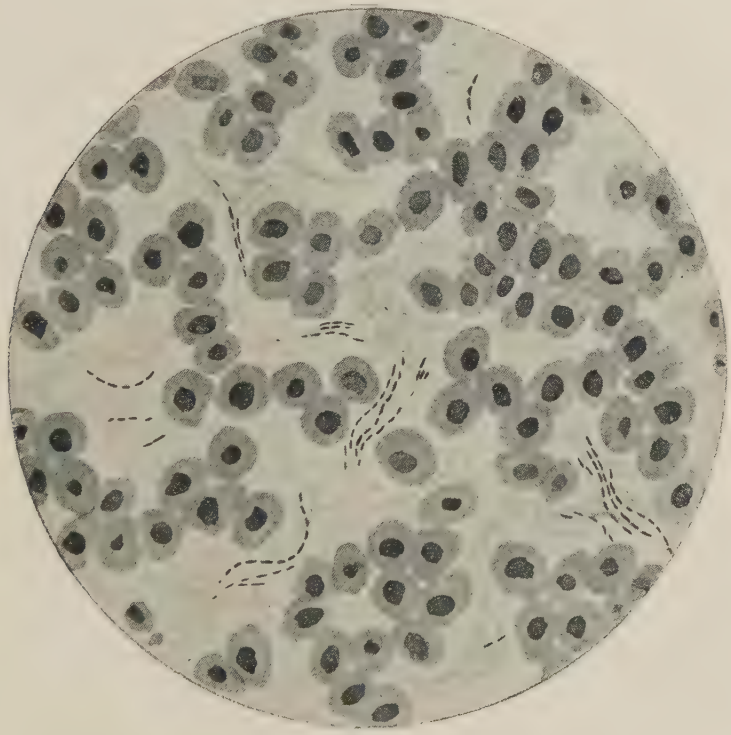


Fig. 246.—Section through the edge of a chancroid, showing Ducrey's bacillus.

An abrasion of the skin is necessary for the penetration of Ducrey's bacillus, but it may be so slight, especially on a mucous membrane, that it is not noticed. The pus may also be introduced into the open mouth of a follicle of the skin.

FREQUENCY OF CHANCROID.

Chancroid is more common among the lower classes than among cleanly and well-nourished people, as its development is favored by

[1] Archiv für Bacteriologie, 1904.

filthy habits and dirty surroundings, and all the accompaniments of privation and misery.

The frequency of chancroid grows less every year, diminished, no doubt, by the increase of cleanliness, and it is most unusual in private practice to see a patient affected with a chancroid.

MODES OF CONTAGION.

(*a*) *Immediate: i.e.,* through direct contact, as in coitus, or by digital examination, etc.

(*b*) *Mediate,* in which contact is not made with the chancroid, but some of the pus is deposited upon an instrument, towel, chamber utensil, water-closet seat, etc., and from this point is brought into contact with another person, who becomes infected.

DEVELOPMENT AND COURSE.

Inoculation generally takes place through coitus, and very rarely through the medium of an instrument or other object.

Twenty-four hours after inoculation a red, hyperemic spot is noted, which on the second day has become transformed into a nodule and on the third day into a pustule with a red surrounding areola. This subsequently breaks down and forms a sore with a crust covering the spot.

Chancroid is usually multiple, although it sometimes exists singly. The fact of the sores being multiple is accounted for in the following ways:—

(*a*) A number of points are inoculated with chancroidal pus at the time of contagion.

(*b*) Through *autoinoculation.*

Autoinoculation may be defined as the action of pus formed in one chancroid producing other chancroids in the same individual: *i.e.,* the inoculation of the patient with pus from his own chancroid, and the phenomenon of autoinoculation is a characteristic feature of chancroid.

The form of the sore depends largely upon its location. If located under the frenum it takes on a figure-of-eight shape and perforates underneath the frenum.

When located upon the penis the chancroid is round, spreading in all directions, and swelling is always present.

If in the sulcus coronarius, a considerable amount of infiltration is always present, because the tissues are naturally denser at that point.

The follicular chancroid, which is formed by infection of a follicle, appears like an acne pustule, and tends not to spread at the periphery, but to go deeply into the tissues.

Its location is generally on the sulcus coronarius and labia majora.

CHARACTERISTICS.

In chancroid there is no period of incubation, and it is generally noticed on the third day after coitus.

The location is usually on the genitals, although it exceptionally occurs on the fingers.

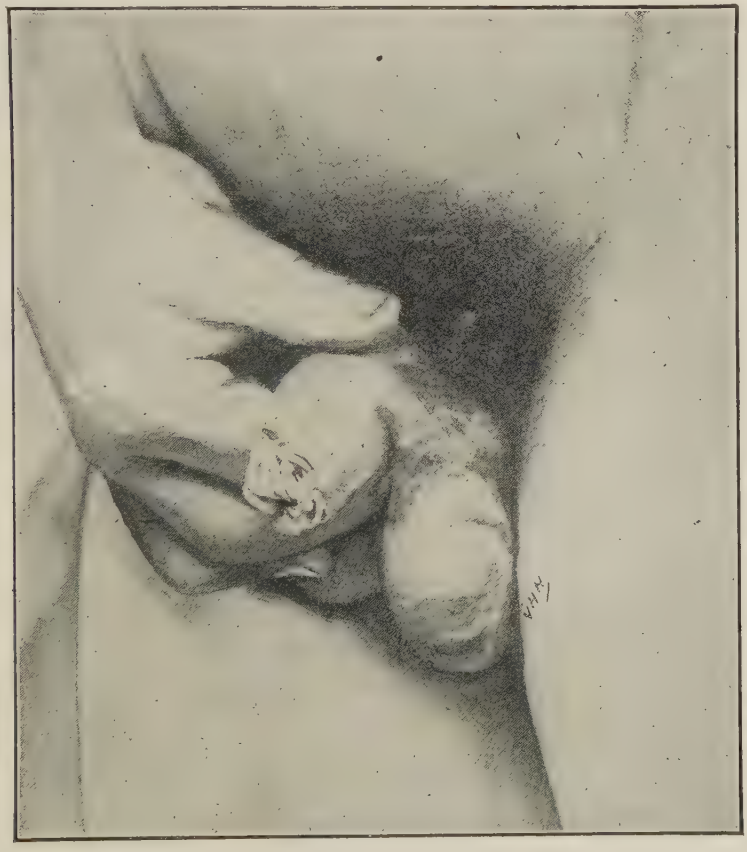


Fig. 247.—Chancroids of the prepuce. (Author's case, from Kings County Hospital.)

In shape the sore is usually irregular from the confluence of several sores, although it may be round or oval.

Number.—It is exceptional for chancroids to exist singly. They are usually *multiple,* either from the simultaneous inoculation of several points at first or from subsequent autoinoculation.

Pain is usually present to a considerable extent.

The base of the sore in a typical case is *devoid of induration,* but if an excessive amount of inflammation has taken place—as a result of insufficient and frequent cauterization, prolonged contact with irritating urine, pus, or acrid secretions—an inflammatory or boggy hardness is often present. This does not feel like the induration of a chancre, which is sharply defined and which resembles a piece of cartilage under the skin, but is doughy or boggy in feeling, and shades off gradually into the surrounding tissues.

Chancroids located in the sulcus coronarius, from the amount of induration which always accompanies them, may be easily mistaken for the initial lesion of syphilis.

The floor of the chancroid is rough and uneven, and covered with a dirty-grayish deposit.

The edges of the sore are undermined; the *discharge* is abundant, purulent, and sometimes bloody.

Duration of the chancroid may be divided into stages:—

I. Progressive stage, during which each sore extends by a breaking down and ulceration of the edges, and fresh sores are continually forming as a result of autoinoculation.

II. Stationary stage. After a time the pus loses its virulence, autoinoculation of fresh surfaces no longer occurs, and the ulcers cease to increase in size, but remain stationary.

III. The reparative stage begins when the sores are covered with healthy granulations and cicatrization is in progress.

The various stages require about six weeks in time for uncomplicated cases, but **relapses from autoinoculation** are very frequent, and delay the healing process.

Microscopic examination of a chancroid shows it to be composed of a small round-celled infiltration which takes place in the skin and subcutaneous tissues, and which leads in time to coagulation necrosis.

The lymphatics are not involved, but remain open and gaping, ready to convey micro-organisms or toxins to the nearest lymphatic gland, and in this way we can account for the frequent occurrence of bubo.

Until 1852 chancroid was regarded as a syphilitic manifestation; yet the true difference between the two diseases would have been sooner discovered but for the **mixed sore.** It sometimes happens that an individual is syphilitic and has accidentally acquired chancroids.

As a result of contact with both poisons, usually during coitus, another person receives a *double infection: i.e.,* the virus of syphilis and that of chancroid are both inoculated at the same moment. The chancroid appears in twenty-four hours, but on account of the longer incubation of syphilis, the chancre is not evident for at least three weeks.

After this period has gone by, the base of the chancroid becomes hard and sclerosed and the sore is transformed into a true chancre which is followed by symptoms of constitutional syphilis.

DIAGNOSIS.

It is often difficult to make a differential diagnosis between chancre and chancroid, particularly in the cases where an excessive amount of inflammation has occurred and a condition of boggy inflammatory induration is present. We should always bear in mind the possibility of a mixed sore being present, and it is usually well to allow three or four weeks to elapse before excluding syphilitic infection.

The principal points to consider in making a differential diagnosis are as follows:—

I. The period of incubation: *i.e.,* the time which elapses between coitus and the appearance of the sore.

II. The *absence* of the cartilaginous induration, which characterizes the primary lesion of syphilis.

III. The ragged, punched-out appearance of the sores, which are usually multiple.

IV. The character of the accompanying enlargement of the inguinal lymphatic glands.

Syphilitic glands are always arranged in a chain resembling a rosary, while the enlarged glands accompanying chancroid are in the form of a packet, on account of the periadenitis, which is always lacking in syphilis.

V. The absence of spirochetæ.

VI. A negative Wassermann reaction.

The bacteriology of chancroid is rather unsatisfactory from a clinical standpoint. Spirochetæ, of course, are absent, except in the case of a mixed sore, and Ducrey's bacilli are very hard to find because the open wound becomes rapidly filled with all kinds of organisms.

They are best found by causing a fresh chancroid by artificial inoculation and examining the pus from the new sore. Another plan consists in covering the sore with collodion. In twenty-four hours the other bacilli are dead on account of cutting off the supply of air, but Ducrey's bacilli are living and can be found with the microscope. While the base of the chancroid is generally soft, if located in the sulcus coronarius or labia minora of women it is usually quite hard, and it also becomes hard if previously treated by burning with silver-nitrate stick.

As the chancroids develop by autoinoculation a difference in the size of the sores also speaks in favor of chancroid, rather than chancre, which if multiple always develops at the same time.

An acute and painful affection of the lymphatics of the penis and glands of the groin, one side alone being affected, is more apt to accompany chancroid than chancre.

The diagnosis of *chancroid complicated by phimosis* is always difficult unless the foreskin can be retracted sufficiently to expose the sore. If marked swelling and redness of the prepuce with painful infiltration and inflammatory hardness of the lymphatics are present, together with a discharge of bloody, foul-smelling pus from under the foreskin, the presence of chancroid rather than chancre is to be suspected. The Wassermann test, if not too early in the disease, may settle the diagnosis. If not positive, however, iodide of potassium may be given internally to cause the healing of a syphilitic lesion, but mercury ought never to be given, as it simply masks the character of the infection and delays other manifestations of syphilis upon which the diagnosis can be made later on.

The finding of spirochetæ would, of course, clear up the diagnosis at once, but unfortunately they cannot be obtained unless the sore can be exposed, as they do not exist in the discharge and the microscopic examination only discloses ordinary bacteria and saprophytes.

Herpes præputialis is sometimes incorrectly diagnosed as chancroid. This mistake ought not to occur if due care is used in the examination. Herpes appears as a number of small vesicles which form upon the glans, prepuce, or skin of the penis. The vesicles soon break, and leave small, round, superficial erosions, which rapidly heal under a simple dusting powder.

TREATMENT.

(*a*) **Abortive.**—If the chancroid is seen early enough, the indication for treatment is to *destroy* the chancroidal character of the sore and transform it into a simple non-infected ulcer.

Methods.—Nitrate of silver should never be used for this purpose, as its cauterizing action does not penetrate deeply enough into the substance of the sore.

Fuming nitric acid was formerly much used, but is now abandoned, on account of its unnecessarily severe caustic action.

The best means of destroying a chancroid is by the Holländer hot-air apparatus, followed by scraping it with a sharp curette. Holländer's apparatus is a combination of a Paquelin cautery and an air pump. The air is heated to a temperature of 400° F. and acts as a caustic, but has a selective action and destroys only the diseased portions of the tissues. This is followed at once by curettage with a sharp spoon.

This method is also useful in making a differential diagnosis between chancroid and chancre. The chancroid can be entirely

scraped away, but a chancre is so tough that it cannot be removed by curetting.

Before using the apparatus, ethyl chloride may be sprayed on the wound, or cocaine injected hypodermically for the pain.

A very good means of cauterizing a chancroid is by means of the *chloride-of-zinc pulp,* which is easily prepared by adding a few drops of water to chloride of zinc. The pulpy mass resulting is applied to the sores and left on for three minutes. Twelve hours later, hot soaks are used to loosen the crust and the granulating surface is dressed with balsam of Peru-silver ointment.

The advantage of the treatment is that all the organisms are destroyed rapidly and completely and the healthy tissue is not injured, as the zinc chloride has a selective action.

If for any reason the chloride of zinc is not used the sores may be touched once daily with tincture of iodine or pure carbolic acid.

It is an error to cauterize every chancroid as a routine measure, and we can lay it down as a rule *never* to cauterize *unless the chancroid* is *free from complications,* as follows:—

Contraindications for Cauterization.—(*a*) If the inflammation is already excessive and much *inflammatory edema* is present, the irritation of cauterizing will increase it.

(*b*) If *inguinal adenitis* is present, the bubo will be made worse by cauterizing the chancroid.

(*c*) In the case of a *healing cicatrizing chancroid* the chancroidal virus has already disappeared, and cauterization is useless.

(*d*) If a *number* of *chancroids* are *present,* and *only a few are exposed,* the entire number should be destroyed, or none at all, for if any are left untouched they will secrete pus, which will infect fresh surfaces.

(*e*) If a chancroid of the meatus or in the urethra is cauterized, the resulting cicatricial contraction after the sore is healed will produce too much deformity of the parts affected.

(*b*) **The methodic treatment** is carried out by means of:—

I. Cleanliness.
II. Antisepsis.
III. Rest.
IV. Heat.

The chancroids should be kept free from the accumulation of discharge by means of frequent washing with solutions of bichloride of mercury, 1:10,000 to 1:5000, or carbolic acid, 2 per cent., or liquor aluminii acetatis.

Dry dressings or dusting powders should only be used **under the foreskin** and never upon a sore located on the integument. The pow-

der, which is exposed to the air, dries, sticks fast, and forms a scab or crust which prevents the discharge from escaping, and the ulceration extends unnoticed under the dried powder. Whenever the dressing is changed the dried powder adheres to the sore, and, on being pulled away forcibly, tears open the wound, affording fresh points for inoculation or destroying the newly formed epithelium at the cicatrizing edge of the wound.

The best and most efficient powder for dressing a chancroid is iodoform, and nothing has ever been found which will answer the purpose as well.

An objection to iodoform is its odor, but, in many cases of chancroid where inflammation is active and the ulceration is extending, iodoform is the only remedy which acts as a specific and checks the tendency to destruction.

The odor of iodoform can be effectually disguised by using a 10 per cent. solution in ether to which a few crystals of cumerine have been added (about gr. ij to the ounce).

The solution is applied to the surface of the chancroid with a medicine-dropper and is quite as active when used in this way as in powder.

In cases where, on account of the objectionable odor, iodoform cannot be used, isoform and airol are two recent remedies which have been found to be the most serviceable.

The use of *hot water,* preferably in the form of a sitz-bath for an hour at a time several times a day, is a valuable adjuvant in improving the circulation, lessening the inflammation, and bringing about a reparative action.

A very good substitute for the sitz-bath consists in immersing the penis in a cup of hot water and soaking it, twice a day for an hour at a time. A few crystals of permanganate of potash added to the water have an excellent effect in increasing its healing properties.

When a healthy, granulating surface of the ulcer announces the beginning of the stage of repair it is desirable to discontinue the iodoform, which is only useful as an antiseptic, and dress the ulcer with a mild stimulant like balsam of Peru or the silver-Peru salve of the Charité:—

℞ Silver nitrate 2
Balsam Peru 20
Vaselin ..... q. s. ad 200

When the chancroid is located **upon the integument** *wet dressings* are called for. The sore should be dusted with iodoform or europhen and covered with a piece of gauze wet with bichloride solution or liquor aluminii acetatis.

A piece of gutta-percha tissue, to prevent evaporation, should be laid over the gauze and held in place with a bandage.

When the granulations become sluggish, a favorite application in Lesser's clinic is camphor wine or aqua chlori. A bandage is wet in the solution and changed every fifteen minutes.

In the so-called *ulcus elevatum,* in which the granulations have grown up above the level of the skin, it is good practice to cut them off with a razor, apply the Paquelin cautery afterward, and dress with iodoform and a wet dressing.

A *mixed infection with gonococci* sometimes occurs, especially in women.

This condition may be well treated by using protargol solution, 1 per cent., as an irrigation, followed by brushing with 10 per cent. nitrate of silver as a caustic, and dressing with bandages wet with 5 or 10 per cent. protargol solution.

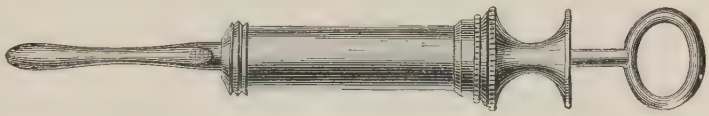


Fig. 248.—Taylor's flat-billed syringe for washing out the balanopreputial sac.

COMPLICATIONS OF CHANCROID.

The accompanying inflammation may at times become *excessive* from such *general* causes as debility or some dyscrasia, or *local* causes, such as a contact of urine or lack of cleanliness. An excessive inflammation, if untreated, is apt to terminate in *gangrene* and sloughing of the parts.

Subpreputial Chancroids Complicated by Phimosis.—When chancroids are located under a long and tight foreskin, the resultant swelling and edema prevent its retraction and render the diagnosis difficult. Artificial inoculation of the patient upon the thigh, with pus from under the foreskin, has been resorted to, to differentiate between chancre and chancroid.

The possibility of the presence of a mixed sore should always be borne in mind in these cases.

TREATMENT.

The preputial sac may be kept clean by the use of antiseptic injections with a flat-billed syringe under the foreskin, using liquor aluminii acetatis every hour or two, and the penis should be soaked in

hot water. An attempt should also be made to retract the foreskin. On account of the danger of paraphimosis, the foreskin should not be left retracted, but drawn back into place.

When the foreskin cannot be retracted the balanopreputial sac should be washed out frequently as above described, and in addition a 10 per cent. iodoform-glycerin solution should be injected under the foreskin several times a day and held in fifteen minutes. The success of this procedure is brilliant, and since its adoption it is rarely necessary to incise the foreskin (Roscher).

In case the swelling increases and surgical interference is not resorted to, the dorsum of the prepuce becomes gangrenous and sloughs in part, or the entire foreskin sloughs off (spontaneous circumcision),

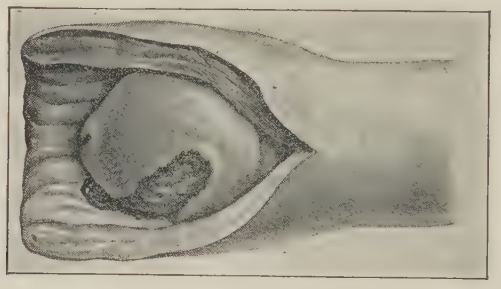


Fig. 249.—Dorsal incision through prepuce to expose chancroids.

or the glans penis becomes gangrenous and sloughs, either entirely or partially.

If gangrene is threatening, recourse must be had at once to **operative measures.** The prepuce should be slit up, upon the dorsum, with a curved bistoury, to relieve the tension.

After exposing the chancroids, in most cases it is better not to use any cauterizing agents upon the sores or on the fresh-cut surface of the prepuce, as an intense reaction always follows cauterization, which delays the convalescence.

With the above treatment there is very little reaction and the wound is healed and ready for circumcision in fourteen days.

Circumcision should never be performed *in the presence of chancroids* on account of the danger of infecting the wound with chancroidal virus, and converting its entire surface into a chancroidal ulcer.

When *chancroid* of *the frenum* exists, the artery is liable to be ruptured during erection and hemorrhage occurs. To prevent this accident, it is proper to tie a double ligature around the frenum, divide the

frenum between the ligatures with a pair of scissors, and cauterize the sore.

Paraphimosis is the condition in which a long foreskin is retracted behind the glans, and, from the swelling and edema which take place in it, is prevented from being drawn back into place. Gangrene and sloughing may result, if the condition is left untreated. After prolonged soaking in hot water, an attempt should be made to replace the prepuce, and if not successful multiple punctures will often allow the serum to drain out and relieve the constriction without ulceration.

If these means are not sufficient the constricting band should be cut upon the dorsum by inserting a curved bistoury under it and cutting outward.

PHAGEDENA.

This, the most formidable of all the complications of chancroid, is rarely encountered at the present day.

It is due to debility of the individual attacked, as a result of some dyscrasia, alcoholism, syphilis, tuberculosis, privation, etc., together with an exceptional virulence on the part of the invading organisms.

Three varieties are noted:—

(*a*) **Gangrenous.**—The tissues die *en masse*. Probably due to a mixed infection with streptococcus and Ducrey's bacillus.

(*b*) **Phagedenic.**—Does not penetrate so deeply, attacking only the skin; more chronic in its course and *perhaps* an autoinfection, caused by Ducrey's bacillus and fusiform bacilli (Rona, Matzenauer), resembling the organism of Vincent's angina or hospital gangrene.

(*c*) **Serpiginous.**—Caused by Ducrey's bacillus (Rona), perhaps also from gonococci (Thelman).

The serpiginous form is very chronic and lasts a long time, healing at one side and spreading at the other.

The etiology of gangrenous, serpiginous, and phagedenic chancroids is not fully understood. It is supposed that they are due to some dyscrasia from excesses, poverty, or alcohol, and that the *exciting cause* is probably a mixed infection with Ducrey's bacillus and streptococcus. In a few cases gonococci have been found. Another view is that the varieties are a form of hospital gangrene of the wounds. In many cases neglect of the chancroidal wound and uncleanliness are responsible for the occurrence of this complication. It occurs at times in strong, hearty individuals, and in these cases the cause is entirely unknown.

In the serpiginous form the infective principle remains active for years.

DIAGNOSIS.

It is always difficult to differentiate these conditions from syphilitic manifestations. The best method of making the diagnosis is by watching the effects of a vigorous course of antisyphilitic treatment.

TREATMENT.

The first indication is to treat the dyscrasia by means of tonics, of which the potassiotartrate of iron in 5-grain doses every three hours is highly spoken of, quinine in tonic doses, and opium for its effect on the pain. Easily digested nutritious food and milk-punch should be administered.

In phagedena, either sloughing or serpiginous, *hot baths* are especially valuable. The patient should spend as much time as possible sitting in a tub of hot water which is maintained at a high temperature.

Under the use of the hot water the sloughing often ceases, and the ulcers take on healthy granulations.

In sloughing phagedenic chancroids, after necrosis has occurred, the separation of the sloughing areas is facilitated by the application of hot fomentations.

Iodoform gauze soaked in wine of camphor is a favorable application in Lesser's clinic. The sloughing variety of phagedena should always be treated very conservatively, and curetting or cauterizing the wound is entirely inadmissible.

In the *serpiginous* form, which is extending, active radical treatment is demanded; the diseased area must be completely destroyed by curetting with a sharp spoon, followed by cauterization with the Paquelin or nitric acid and subsequently the free use of an iodoform dressing. Absolute rest in bed is, of course, imperative.

In the serpiginous form the history of an old syphilis can often be obtained, and, while the disease is not a syphilitic manifestation, iodide of potassium internally is often very beneficial. Mercury should not be given, as it is too depressing to the already lowered vital forces.

BUBO.

The term bubo is applied to the inflammatory enlargement of any lymphatic gland, but especially in the inguinal region.

It accompanies chancroid in from 30 to 50 per cent. of all cases, and is more common in hard-working men than in women and well-to-do persons, for muscular activity predisposes strongly to its development.

ETIOLOGY.

It was formerly not known whether the inflammation of the lymphatic glands was caused by the micro-organisms formed in the chancroid and carried through the lymphatic vessels, or whether it was due to a deposit of toxins in the glands.

It is now known that buboes are caused not by the toxins, but by the presence of Ducrey's bacillus in the glands themselves. Buboes have been incised, their walls scraped with a sharp spoon, and Ducrey's bacillus found. After twenty-four hours, mixed infection occurs and the streptococcus can be identified.

COURSE.

One gland alone may be infected, but, as a rule, the whole chain on one side is involved, and it is not infrequent for several glands on both sides to be attacked.

The chancroid may be located on the right side, while the bubo occurs on the left side, or *vice versâ,* and it occurs most frequently when the sore is located on the frenum or sulcus coronarius.

Exceptionally the involvement of the glands may disappear by resolution, but in the great majority of cases the glands suppurate and break down. The suppuration and softening of the whole gland may run a comparatively rapid course, but, on the other hand, the process of softening of the chain of glands, their breaking down and suppuration, the slow evacuation of the pus through a small opening, may be a very protracted one, and may last for months unless the diseased glands are completely extirpated by surgical measures.

In cachectic individuals, buboes run a very chronic course, and often break down and ulcerate slowly.

Bubo occurs less frequently in women than in men, because women's occupations do not require so much bodily activity.

A common cause of bubo is the frequent cauterization of a chancroid with nitrate of silver. This causes a crust to form over the sore, and the organisms cannot escape from the wound; they make their way into the lymphatic glands, and swelling and suppuration are more apt to occur.

After a bubo breaks down and discharges, the wound may become converted into a chancroidal ulceration, either serpiginous or sloughing.

If sepsis occurs, it is due not to Ducrey's bacillus, but to a mixed infection with streptococci.

Lymphangitis, or a swelling and inflammation of the lymphatic vessels, frequently occurs as a complication of bubo.

Bubo d'Emblée is a term frequently used in France, and is applied to the cases when a bubo occurs without a history of a sore.

It is always caused, however, by a previous sore, which may have healed at the time the bubo first appears.

In making the diagnosis of bubo, the possibilities of cryptorchism, or hernia, or enlargement of the inguinal glands, from tuberculosis or carcinoma, should be borne in mind.

The accompanying table indicates the chief points of difference between the glandular enlargement of syphilis and that of chancroid:—

DIFFERENTIAL DIAGNOSIS OF BUBO AND SYPHILITIC ADENOPATHY.

Chancroid.	Syphilis.
One side affected, as a rule.	Both sides affected.
Shape:	*Shape:*
Irregular and boggy.	Regular, smooth, and hard.
Size:	*Size:*
Large.	Small.
Number:	*Number:*
May be single.	Always multiple and arranged in a chain.
General Characteristics:	*General Characteristics:*
Considerable amount of inflammation, causing adherence to overlying skin. Generally suppurate.	No inflammation. Not adherent to skin, but freely movable. Do not suppurate.
Packet form.	Rosary form.

TREATMENT.

The indications are:—

I. To prevent suppuration.

II. After suppuration has taken place, to evacuate the pus and extirpate the diseased glandular structures.

I. To prevent suppuration, the most important measure is *rest in bed*, supplemented by the pressure of a sand-bag over the inflamed gland, together with warm applications.

The ice-bag is no longer used, because it has been found that warm applications cause resolution just as well.

Gauze wet with warm liquor ammonii acetatis, applied over the gland, and a sand-bag above it, is a suitable dressing.

A favorite method of treating buboes before suppuration, in Lesser's clinic, consists in wearing gauze wet with 95 per cent. alcohol, next the bubo covered with non-absorbent cotton and gutta-

percha tissue, with holes cut in it, over all. Alcohol is poured on the dressing twice a day, to make up for the loss by evaporation.

The Bier hyperemia treatment has also been successfully applied to buboes by using a glass bell applied over the swelling for five minutes at a time, with an interval of three minutes, and then a repetition until three applications have been made, and the Bier treatment is also useful after incision of the bubo and evacuation of the pus.

Tincture of iodine painted around the gland, or the following salve rubbed in, is also used in some ambulatory clinics:—

℞ Tinct. iodine ..... 2 parts
Potass. iodine ..... 3 parts
Lanolini .....20 parts
Sig.: External use.

II. Treatment After Suppuration.—When fluctuation is noted, the suppuration should be hastened by hot applications, instead of warm.

The thermaphore is very useful in keeping the applications hot in these cases. The hot applications are continued until the gland has fully broken down, and when it is soft all over, and full of pus, a small incision with a double-edged knife should be made, and the pus evacuated. Iodoform glycerin, 10 per cent., is then injected into the cavity. The emulsion should be injected three times at the first sitting. The first two injections run out, and the last one remains in.

The wound is then bandaged with gauze, moistened with liquor aluminii acetatis. On the following day the wound is emptied by squeezing, and iodoform emulsion injected once and left in.

The bandage is then applied, and in five or six days the wound is closed and healed. If after a week the wound is not closed, it should be injected again, and in five or six days the wound has usually healed, and the bubo disappeared.

The method of injecting the wound with silver nitrate is abandoned, on account of the pain which is caused, and because it is no better than the injection with iodoform.

The plan of encouraging suppuration and evacuating the pus through a small incision is satisfactory in most cases when the glands break down rapidly, but sometimes the suppuration goes on very slowly, and it is better to make a free incision, evacuate the pus, dissect or curette out the partially broken-down remains of the glands, pack the wound with gauze, and allow it to heal by granulations.

It is better to avoid this if possible, as the subsequent healing takes six or eight weeks, and requires daily dressings.

It was the practice a few years ago to endeavor to prevent sup-

puration in the glands by making a curved incision over them, dissecting them out, and closing the wound by suture.

This practice has now been abandoned, because it was found that a permanent edema, resembling elephantiasis of the penis and scrotum, and inguinal region, followed in consequence of the obliteration of the lymphatic vessels in the process of wound healing.

Another objection was that, when patients came to operation, suppuration had nearly always begun in the center of the gland, even though no fluctuation was evident; the wound was not aseptic, and could not be closed, but had to be left open, for the slow process of healing by granulation.

In cases when a bubo has broken down, become infected with chancroidal virus, and converted into a **serpiginous ulceration,** the following treatment is a favorite one at the Charité, in Berlin.

It is also useful in old, indolent chancroids, or any chronic ulcerative process.

Technique.—The edges and surface of the wound are scraped with a sharp spoon, and afterward seared superficially with the Paquelin. The surface is then brushed over with 10 per cent. zinc chloride solution, and a bandage of iodoform gauze, wet with wine of camphor, applied.

As soon as granulations are on a level with the skin, and very little pus is present in the wound, it should be dressed with a nitrate of silver salve.

℞	Silver nitrate	2
	Balsam Peru	20
	Vaselin	q. s. ad 200

Under this treatment these ulcerations heal satisfactorily.

SYPHILIS AND ITS LESIONS.

CHAPTER XX.

SYPHILIS.[1]

In the last few years four important facts have been discovered which have entirely changed our ideas in regard to the etiology and treatment of syphilis. These are:—

1. The possibility of communicating syphilis to animals.
2. The discovery of the *Spirochæta pallida*.
3. The serum diagnosis of syphilis by the Wassermann reaction.
4. The use of salvarsan.

EXPERIMENTAL SYPHILIS.

In 1903 Metchnikoff and Roux established the fact that, in chimpanzees inoculated with syphilitic material, local and, as a rule, also systemic reactions were produced, which resembled the reactions of human syphilis, and from these animals other animals could be inoculated. With the lower apes the local lesions were somewhat less characteristic, but material from these lesions was pathogenic for chimpanzees, like material from human syphilis.

This work was repeated and broadened by Metchnikoff and Roux at the Pasteur Institute, by Neisser, Landsteiner, and Finger, and also by Kraus in Vienna. The results were all in accord with the general observation that higher and lower apes may be infected with syphilis, and that with the higher apes the course of this syphilis resembles the disease in the human subject more closely than does the disease in the lower apes, for in the latter only local lesions result.

With the lower apes the healing of the primary lesion marks the termination of the disease as a rule, but with the higher apes, particularly with the chimpanzees, eight to ten weeks after the inoculation there appear symptoms of a generalized secondary syphilis: macular and papulosquamous exanthemata over the entire skin surface, on the palms of the hands and soles of the feet, and necrotic, sloughing pap-

[1] The author desires to express his thanks to his friends, Surgeon-major Curt Roscher, of Berlin, for his valuable assistance in the preparation of the chapters on syphilis, and information in regard to recent discoveries, and to Dr. Alfred Potter, of Brooklyn, for the chapter on the Wassermann reaction. The following works have also been abstracted from freely: "Beiträge zur Pathologie und Therapie der Syphilis," by Prof. Albert Neisser, 1911; "Syphilis from the Modern Standpoint," by McIntosh & Fildes, 1911; "Der Umschwung in der Syphilis Behandlung," Touton & Fendt, 1911.

ules on the mucous membranes. That all of these symptoms are truly of a syphilitic nature is proved by the following facts:—

1. After inoculation with syphilitic material and after an incubation time which agrees perfectly with that of man, there occurs a complete clinical picture of syphilis.

2. That this affection is contagious for apes and can be further inoculated through numerous generations.

3. That the histological picture of the primary sore, induration, etc., in apes agrees perfectly with that of man, and that in the tissues of apes, even in later generations, the cause of syphilis, the *Spirochæta pallida,* can be demonstrated.

It has also been shown that not apes alone are susceptible to syphilis: the introduction of syphilitic material into the anterior chamber of the eye produces, in rabbits, an iritis and a syphilitic keratitis. The spirochæta can be demonstrated in these lesions and material inoculated with positive results in other rabbits. Hoffmann reports similar results in dogs and sheep.

He also showed that the blood of syphilitics, even in the sixth week after the infection, was able to produce syphilis in apes through inoculation; therefore, the blood must contain the syphilitic virus. Also in this connection may be mentioned the infectivity of gummata. Neisser and Finger were able to produce a positive infection in apes after inoculating them with material taken from the periphery of a gumma. Landsteiner and Finger were also able to produce syphilis in apes by the inoculation of semen from a syphilitic man.

Of peculiar interest is the behavior of tertiary syphilitics toward a fresh infection. They develop an inflammatory erythema, in the center of which a brownish-red infiltration appears which later shows all the appearances of a tertiary skin lesion. Therefore, immunity of syphilitics to reinfection apparently does not exist. It has also been shown that as long as one is in a florid state of syphilis he can be reinoculated not only by material from his own lesions, but also by material from lesions in others. Apparently a syphilitic can be reinfected at any time, but the symptoms become milder as the disease progresses. There is a progressive but no absolute immunity.

In regard to the channel of infection, the primary seat of inoculation in acquired syphilis is almost always a surface covered with squamous epithelium. Cutaneous inoculations are alone successful. Thus in apes and monkeys the virus must be introduced into the scarified epidermis and apparently the epidermis must be damaged. Neisser's experiments with animals of rubbing virulent material into the undamaged surface of the tonsil, conjunctiva, and nasal mucosa

were all negative. Subcutaneous, intravenous, and intraperitoneal inoculations were also negative.

In man, apparently for this reason, small, superficial wounds are more dangerous than deep ones. The virus is destroyed by heating for one hour at 51° C. and remains virulent only six hours after removal from the body.

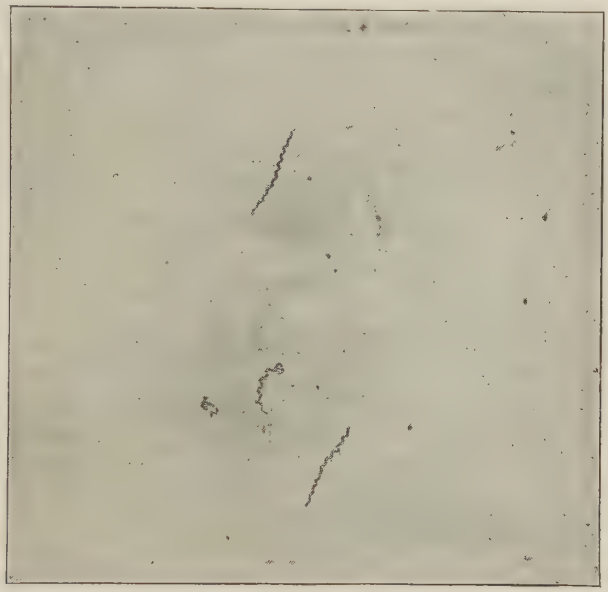


Fig. 250.—Spirochæta pallida. (Courtesy of Hoagland Laboratory.)

DISCOVERY AND MORPHOLOGY OF SPIROCHÆTA PALLIDA.

In 1905 Schaudinn and Hoffmann discovered two forms of spirochætæ occurring in syphilitic lesions, not only in superficial but also in deep lesions and in the connected lymph-glands.

The first form, or *Spirochæta pallida,* which is now known to be the specific cause of syphilis, is a very delicate spirillum, from four to fourteen microns in length and one-quarter of a micron or less in diameter. It shows from six to fourteen sharp, spiral coils resembling a corkscrew, has bipolar flagella or cilia, and progresses by rotating upon its long axis, and when at rest shows undulatory movements throughout its whole length. There is still some dispute as to its exact biological position, but the weight of evidence seems to be in favor of its belonging to the family of protozoa and not to the bacteria.

The second form, or *Spirochæta refringens,* which has nothing to do with syphilis, is a coarser organism, ten to fifteen microns in length and

one-half to one micron in diameter, with three to five loose coils. It is a constant inhabitant of the mouth and mucous surfaces, and has often been found associated with the *Spirochæta pallida.*

OCCURRENCE OF THE SPIROCHÆTA PALLIDA IN SYPHILITIC LESIONS.

The organism may be demonstrated in the expressed fluids of chancres, in the aspirated or spread tissues from the neighboring lymph-glands, in the skin of the primary roseola, in all of the secondary cutaneous lesions,

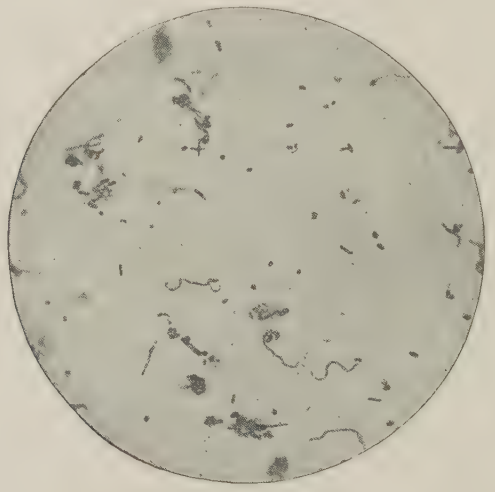


Fig. 251.—Spirochæta refringens. (Courtesy of *Dr. Roscher,* Berlin.)

in mucous patches and ulcers of mucous membranes, in the sputum when the mouth is affected, and in condylomata. In a few cases they have been found in the circulating blood. According to Hoffmann, the organism is seldom found in the cerebrospinal fluid, and the fluid itself is non-infectious except in very rare cases. The semen of syphilitic men is infectious, but the spermatozoa are not believed to be invaded by the organism. It is more likely to be found in the surrounding fluid.

By Levaditi's silver stain the organisms can be demonstrated in the tissues. In the chancre they are not abundant in the ulcerated surface, but beneath and about it, in and between the epithelial cells, in the subepithelial and perivascular lymph-spaces, especially about the growing endothelium of new capillaries, in and beyond the areas infiltrated by plasma cells, and lying within leucocytes and other phagocytes.

In lymph-nodes they are abundant in the peripheral lymph-sinuses and in the capsules and trabeculæ. In the internal organs of adults the

spirochæta is very scarce, but it has been found in the adrenals, aortic wall, and nerve-trunks.

Gummata usually fail to show any organisms, and large quantities of the material are required for successful inoculations. When present at all the spirochætæ are in very small numbers.

Hoffmann believes that the organisms enter the lymph-spaces of the rete, where they are protected against phagocytosis, or immediately make their way into the lymph-vessels of the papillæ. Only after about three weeks, when multiplication has taken place, does a reaction occur. The first changes then would be an endo- or peri- lymphangitis, followed by budding of capillaries, infiltration, and connective-tissue hyperplasia. According to the findings of Ehrmann, the lymph-vessels are involved secondarily, the earliest changes taking place in the connective-tissue interstices, followed by new capillary formation and perivascular infiltration. The evolution and histology of the roseola and papule seem to show that these lesions are embolic rather than toxic.

While the *Spirochæta pallida* is an extracellular parasite, it suffers extensively from phagocytosis and undergoes progressive intracellular digestion by several types of cells, not only in primary but also in secondary lesions and in congenital syphilis. So prominent and constant is this process that one may safely conclude that phagocytosis is an important if not the chief means of defense on the part of the body against syphilitic infection.

While the presence of the specific organism of syphilis in cases of primary, secondary, and even tertiary infections is by this time a well-established fact, in those complaints which are called by the general name of "parasyphilitic affections" the many investigations which have been made up to the present time have all been negative as regards the presence of the *Spirochæta pallida*.

The researches of Neisser have shown that the spirochætæ leave the infection area very shortly after the inoculation, and invade the surrounding tissues. Neisser, by excising the inoculation sites at different intervals of time, demonstrated that only by excision within twelve hours was it possible to prevent the onset of the disease.

In a later research he showed that the internal organs of monkeys, even during the incubation period, might contain the virus. In the case of the blood the virus was present as early as the fifth day after inoculation, and, in the case of the spleen, the twelfth day.

The actual invasion of the organism is due to the spreading of the spirochætæ along the lymphatic and perivascular spaces. Nevertheless, the blood plays a part in the dissemination of the parasites. It

has already been stated that the blood is frequently infective, and, further, that the finding of *Spirochætæ pallida* in the blood, and the demonstration of the parasites in the blood-vessels in primary lesions, as well as in those of congenital syphilis, all point to a generalization of the virus by the blood as well as by the lymphatics.

HISTOPATHOLOGY OF SYPHILITIC TISSUES.

Primary Sores.—The serous discharge from an untreated chancre contains large numbers of spirochætæ, especially after it has broken down, but it is difficult to find them in chancres which have been present some eight weeks or more.

In the early chancres there is an irregular distribution of spirochætæ, and the agglomerations are found in the tissue immediately surrounding the blood-vessels, and in the walls of the blood-vessels themselves, causing the peri- and end- arteritis so frequently seen in these lesions.

They are found in large numbers in the lymphatic spaces, lying with polynuclear leucocytes, and in the Malpighian layer of the epithelium before it has broken down.

In ulcerated chancres *Spirochætæ pallida* are often present in considerable numbers along with forms of spirochætæ and bacteria in the *débris* on the surface.

In chancres of a phagedenic type *Spirochæta pallida* is often found with difficulty, while large numbers of micro-organisms can be demonstrated in the discharge and tissues.

Lymphatics.—*Spirochætæ pallida* are also present in the lymph-channels leading from the primary sore, and are abundant in the regional glands, being most numerous in the connective tissue forming the trabeculæ of the gland and in the perivascular tissue, as demonstrated by Levaditi and others.

Roscher found them in the fluid obtained by puncture of the gland thirty times out of thirty-eight attempts.

Secondary Lesions.—The lesions of secondary syphilis are due to the fact that the spirochætæ, soon after their generalization through the entire system of the host, tend to multiply rapidly in certain structures, usually epithelial, for which they have a special predilection.

They reach a suitable focus for multiplication by spreading along the walls of the blood- and lymph- canals, or through the general blood-circulation.

This localization is followed by a reaction on the part of the tissues, and in time by more or less injury to the part affected.

Microscopic examination of a syphilitic papule in the secondary stage shows marked vascular changes, endarteritis being present in many places in the smaller blood-vessels, with collections of small round cells in their immediate neighborhood.

The distribution of the spirochæta is very irregular, though it has been found in most of the secondary lesions and they are most numerous in the deeper layers of the epidermis and surrounding capillaries of the papillæ.

The various syphilitic eruptions on the skin are the result of the invasion by spirochætæ of the deeper layers of the epithelial cells of the papillæ and mucous patches; condylomata, orchitis, and various other lesions are the result of injury to the cells by the spirochæta, being deposited at those points.

Internal Lesions.—But little information has been obtained regarding the distribution of spirochætæ in the internal organs, as there are but few records of autopsies, and we can only draw analogies from the autopsy findings in the cases of congenital syphilis.

Blood.—The number of spirochætæ present in the blood, as already stated, is very small, but a few positive results have been obtained.

TERTIARY SYPHILIS.

The demonstration of *Spirochætæ pallida* was unsuccessful as the first attempts in tertiary syphilis, but they were finally found by Spitzer and Doutrelepont and Grauven, and they are known to be present in gummata, syphilitic aortitis, and periostitis.

Schaudinn demonstrated that the spirochætæ are chiefly present in the periphery of the necrotic areas.

In sections of the livers of children dying from congenital syphilis, gummata are found in all stages. In the very early stage of the gumma spirochætæ are found in the wall of the blood-vessels as well as within the surrounding cellular infiltration, but, as soon as the artery becomes obliterated and degeneration sets in, the spirochætæ also degenerate and disappear.

CONGENITAL SYPHILIS.

Congenital syphilis may be regarded as a form of spirochæta sepsis or an acute invasion of the entire system, which is overwhelmed by the numbers of the organisms, which are found in great abundance in nearly all the organs.

In 53 syphilitic infants Bab found the spirochæta in the lungs in 87 5 per cent.; in the pancreas in 80 per cent.; in the skin, nose, and

eyes in from 66.7 to 25 per cent. They are usually most abundant in the liver, adrenals, and intestinal wall.

In the *liver* they are universally present, and usually in very large numbers, as well as in the suprarenal glands, and these organs may be regarded as predilection sites for the spirochæta.

In the *spleen* the number of spirochætæ is never very great and the distribution is irregular. The scarcity of spirochætæ is regarded by Levaditi as a result of the energetic destruction of the parasites in the spleen.

Spirochætæ have been found in the *eye lesions* of early cases of congenital syphilis, such as keratitis and iridocyclitis, and also in the optic nerve itself. It is therefore probable that the various stigmata of congenital syphilis are the result of the direct working of the spirochæta.

In all the *skin lesions* of early congenital syphilis, whether maculopapular or pemphigoid, spirochætæ are present in enormous numbers.

The *maternal portion of the placenta* is almost always free from organisms, but they are found in the blood-vessels and stroma of the fetal villi, and also in the arterial and venous walls of the umbilical cord.

According to Colles's law, a mother who gives birth to a syphilitic infant may not herself contract the disease, and thereafter remains immune to inoculation. This law may be explained by the infection of the embryo or ovum and the transference of immunity to the mother by the blood.

Lucas thinks that inheritance from the father alone is impossible, and it follows that infection of a mother by her syphilitic fetus can never occur. He asks how it is possible that an organism which is highly motile, and the length of which averages more than the diameter of a red cell, can penetrate an ovum $\frac{1}{200}$ inch in diameter, and multiply without destroying it. He lays it down as an axiom that inheritance is invariably through the syphilized mother, and believes that the organisms when virulent penetrate the chorion or placenta and cause miscarriages, macerated fetuses, or premature births; but when the virus is attenuated by time or treatment, the placenta forms a complete protection to the developing fetus, and it is the separation of the placenta at birth which allows infection to take place through the umbilical vein. Hence the regularity of the secondary exanthematous stage from a fortnight to three months after birth. Bauer tested the parents of syphilitic children for the presence of the disease, and found that mothers of these children gave a positive serum reaction for syphilis even though clinically they were quite free from

all signs and symptoms of it: the fact of Colles's law seems to depend therefore upon the presence of latent syphilis in the mother. The same cause explained the seeming immunity of children to infection with syphilis, the presence of the disease in them being shown by a positive serum reaction, although clinically they too seemed to be free from the disease.

METHODS OF EXAMINATION FOR SPIROCHÆTÆ.

Obtaining Material for Examination.

1. *Irritation Serum Method.*—This method can be used for examining eroded efflorescences, such as the primary lesion, condylomata, and ulcerating syphilides.

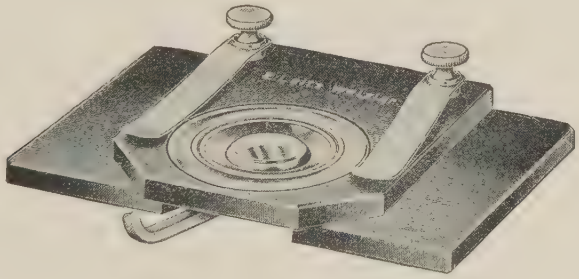


Fig. 252.—Reflecting condenser for dark field.

The ulcerated surface is first cleansed with physiological salt solution and dried with sterile gauze. The surface is then rubbed with sterile gauze or lightly scraped with a platinum spatula, until the serum flows abundantly, always avoiding drawing blood. The flow of serum is facilitated by squeezing the sore between the finger and thumb. The serum is then placed upon a glass slide. The spirochætæ can be examined living or stained.

2. *Suction Method.*—The serum can also be obtained after cleansing the sore by placing a Bier hyperemia cup over it. After a few minutes clear serum is obtained, which is placed upon the glass slide. All other methods, such as excision of the chancre or papule, puncture of the glands, and examination of the blood-sediment, have no value for diagnostic purposes, and are only used for an experimental object.

DEMONSTRATIONS OF THE LIVING SPIROCHÆTA PALLIDA.

Preparation of the Specimen.—After a drop of the serum is placed upon a glass slide, which has been thoroughly cleansed with alcohol, it is carefully covered with a cover-glass.

Dark-field Illumination.—For observing the living spirochætæ the method of dark-field illumination is the one to be preferred, and is now generally used, for the organisms appear very distinctly as pale-white, undulating bodies against the dark background.

A great advantage in examination by the dark field is that there is no distortion of form or size, and the movements can be watched.

An intense source of light is requisite, and the microscope must be provided with the funnel-shaped condenser, inside of the oil-immersion lens, as well as the dark-field condenser.

Before placing the slide under the microscope a drop of cedar oil is put on top of the slide and another drop of cedar oil underneath it. The specimen is then examined with the oil-immersion lens.

India-ink Method of Burri.—1. A drop of the fluid to be examined

Fig. 253.—Tube and funnel necessary to use with oil-immersion objective.

and a drop of fluid india ink are placed upon a glass slide and mixed together with a platinum loop.

2. The preparation is dried in the air.

3. Examined with the oil-immersion lens.

The spirochætæ appear light against the dark background, and can be recognized by their form, undulations, and length.

Sterilized Chinese india ink must be employed, and, before using, it is to be diluted with distilled water 1 : 10.

The india-ink method is simple and requires no special instruments.

Demonstration in Smears on a Glass Slide by Fixation and Staining.—These methods formerly in general use have been at the present time generally discarded in favor of the dark-field illumination.

The staining may be employed as follows:—

The serum must be smeared with a platinum loop in the thinnest possible layer upon a glass slide and dried in the air.

The most common method of staining is by the Giemsa method, as follows:—

Giemsa Method.—The preparation is allowed to dry in the air and then fixed by carefully passing through the flame. In a clean test-tube,

previously rinsed with hot alcohol and then with distilled water, place 10 c.c. of a 0.5 per cent. watery glycerin solution, and add 13 drops of Giemsa's solution (Grübler). Mix thoroughly, heat to boiling, and if no precipitate appears pour on the slides, allowing it to remain for three minutes. Then pour off the stain, rinse the preparation in distilled water, and apply the stain again (a third time if necessary) as above. When sufficiently stained the film appears a deep pink with a slight metallic luster when dry. Rinse in water. Dry without heating, add a drop of cedar oil, and examine directly with a one-twelfth immersion lens. The *Spirochæta pallida* appears an intense pink. The *Spirochæta refringens*

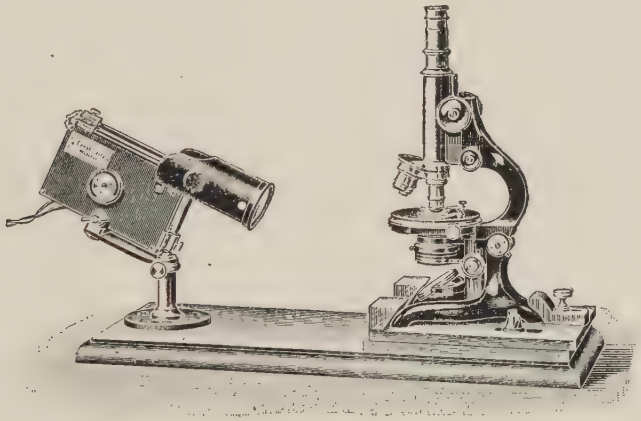


Fig. 254.—Arrangement for lighting the dark field with electric light.

of balanitis and other non-specific lesions stains equally well, but may be distinguished by its greater thickness and by its wavy convolutions.

(For other methods see Appendix.)

ANALOGY BETWEEN SYPHILIS AND THE ERUPTIVE FEVERS.

A distinct parallel, which has been pointed out by Jonathan Hutchinson, exists in the course of syphilis and small-pox, measles, scarlatina, etc. All these diseases are due to a special and distinct poison, which is introduced into the body. After a period of incubation, during which the virus increases in volume, its quantity becomes so great that the organism is saturated with it, and constitutional symptoms occur. Each disease runs its own definite and self-limited course, and afterward a condition of immunity follows, which lasts for years, or often for the remainder of the life of the individual.

The modern view of syphilis is that it is an overwhelming of the entire body occurring at the beginning of the secondary period by the

spirochætæ, which remain in the tissues that offer a suitable pabulum for them.

In most of the situations to which they gain access they are destroyed either by the effects of treatment, the formation of antibodies, or phagocytosis, but in certain places they remain without increase until an irritation occurs, causing them to increase in numbers and form a lesion at the point of deposit.

All the early secondary relapses and the late tertiary ones as well, such as tabes, cerebral and visceral syphilis, are today supposed to be the result of spirochætæ that have remained latent in the organs affected from the time of the original infection.

INOCULATION AND COURSE OF SYPHILIS.

Fournier describes the course of a case of syphilis as a drama or tragedy, with acts and pauses, and represents its course graphically by the following diagram:—

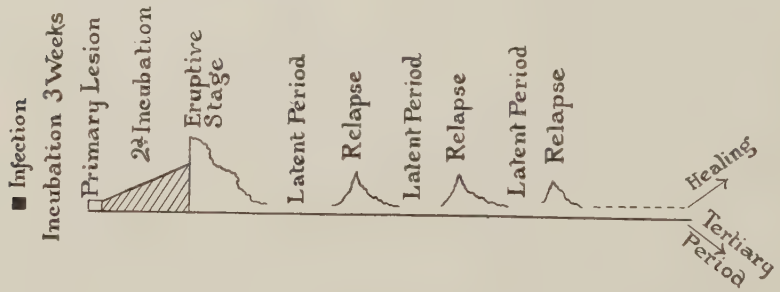


Fig. 255.—Fournier's syphilis curve.

After inoculation with the virus of syphilis no symptoms are observed at the point of entrance or elsewhere for a period of *at least three weeks.*

It is supposed that at this time the spirochætæ are too few in number to cause any reaction of the tissues, but, as they increase in number, they induce a condition of local irritation, and the chancre appears. The virus continues to increase, is taken up by the lymphatic vessels and carried to the nearest lymphatic glands, which serve as incubating places for the micro-organisms. The glands undergo enlargement successively, and ultimately the virus reaches the general blood-circulation.

When saturation of the blood has occurred, the fact is announced by prodromata, which are soon followed by an eruption on the skin and mucous membranes. Later the eye, periosteum, and viscera are attacked by inflammatory changes, consisting of arteritis and small round-celled infiltration.

The eruption remains upon the skin for from four to six weeks ordinarily and then disappears, and for a time no symptoms of the disease are present. This interval in the manifestation is spoken of as a period of latency.

By a **period of latency** is understood today to mean only that manifestations of the disease are not visible on the skin or mucous membranes, but the spirochætæ are still present in the body.

Relapses followed by periods of latency occur at intervals of from three to six months during the entire course of the disease, and it is noted that relapses are more apt to take place in patients who have had little or no treatment.

In the majority of cases which receive systematic and adequate treatment relapses cease after from one to three years. But it does not necessarily follow that the syphilis is at an end because a considerable length of time passes without a relapse. After a period of latency, which may extend over many years, new symptoms may again develop.

The *late lesions* differ from the early ones, in that they are of a grave nature and do not tend to spontaneous recovery, but are more apt to destroy the organs attacked. The secretion which they furnish has also lost its contagious properties.

MODE OF INCREASE OF THE VIRUS.

After reaching the blood-current the spirochætæ have the property of passing through the walls of the blood-vessels by osmosis, and are deposited at various points in the tissues. Wherever the virus is deposited, local inflammatory infiltration occurs.

As the spirochætæ are present in all the lesions, their secretions and detritus can produce syphilis if inoculated into another individual.

As a consequence of the growth and activity of the spirochætæ toxins are formed which have a poisonous effect upon the nervous system and occasion fever, headache, and backache. It is also supposed that antibodies are produced as well, which have their effect in destroying or neutralizing the parasites.

STAGES OF SYPHILIS.

It is found convenient to divide the regular course of syphilis into three stages, as follows:—

I. **Primary stage,** which includes the time from the moment of infection to the outbreak of the general symptoms (eruptions and mucous patches, etc.), and which lasts from eight to ten weeks.

For the first three weeks of the primary stage there are no obvious symptoms to indicate that the individual contains spirochætæ in his tissues,

although they can be found microscopically. At the end of three weeks the chancre appears, and the adjacent glands become enlarged and are the only signs of infection.

II. **The secondary stage** begins when the eruption, alopecia, and mucous patches make their appearance. It is the stage of typical and regular development of eruptions, their accompanying symptoms and periods of latency alternating with relapses. The secondary stage lasts from six to eighteen months, or about one year on the average.

III. **The tertiary stage** comes on after a prolonged period of latency, and is the stage of formation of gumma. The tertiary stage may never occur. Its secretions are not contagious, and it resembles a *diathesis* more than an active disease, for although spirochætæ are present they are few in numbers.

INCUBATION.

Definition.—The period of time which elapses after the spirochætæ have entered the body until the first manifestation of their working appears. The poison is not inactive during this time, but increasing in quantity.

The primary stage of syphilis is divided into two periods of incubation:—

(*a*) *Period of primary incubation,* which is the period from the time of infection until the chancre appears. The chancre represents the reaction of the tissues in consequence of the local increase of the virus.

(*b*) *Period of Secondary Incubation.*—This is the time from the appearance of the chancre until the eruption is seen. The eruption indicates that the blood is saturated with the virus.

GLANDULAR ENLARGEMENT.

The lymphatic glands are supposed to act as places for the incubation, growth, and development of the syphilitic virus, and to serve as storehouses for it, during the entire secondary stage. The glands nearest the chancre begin to enlarge about four weeks after infection.

General Characteristics.—The glands become:—

(*a*) Firm and hard, arranged in a chain, resembling a rosary.

(*b*) Freely movable under the skin.

(*c*) No pain.

(*d*) Rarely suppurate except in strumous or weak patients.

The glands nearest the chancre become enlarged first; consequently we find that, when the chancre is located on the *penis,* the *inguinal* glands enlarge first; when the seat of the chancre is on the *breast,* the *axillary* glands are the first to become affected; and if the

chancre is located on the tongue or lips, the *submaxillary* glands are first attacked.

After the syphilis has become general, all the lymphatic glands throughout the body are enlarged, and when located superficially are easily felt.

For diagnostic purposes, the enlargement of the paramammillar and postauricular glands is the most reliable.

The epitrochlear and postcervical glands are less to be depended upon, as they may enlarge from other causes.

As a general rule the glandular swelling disappears in the tertiary period, *i.e.*, two or three years after infection.

The **lymphatic vessels** lying between the glands often become hard and indurated, feeling like cords, and this condition is called *lymphangitis*.

Course of Virus Through the Lymphatic System.—The syphilitic virus pursues the following course, in its progress through the lymphatic vessels into the general blood-circulation:—

The small round-celled infiltration, which occurs in the chancre, closes up the mouth of the blood-vessels and temporarily holds in check the spread of the spirochætæ. The multiple swelling of the lymphatic glands also retards the entrance of the virus into the blood-current.

After the virus begins its increase in the chancre, a part of it is carried to the nearest lymphatic gland, which is a favorable spot for its growth and increase. Part of the virus which is deposited here remains and a part travels farther to the next lymphatic gland.

When the chancre is located on the *penis*, the course of the virus is as follows: Through the inguinal glands, lymphatic glands in the abdominal cavity, receptaculum chyli, and thoracic duct, from which it is poured into the left subclavian vein and general blood-circulation.

During this time the cervical and axillary glands have had none of the virus passing through them. After the blood has become charged with the virus, they filter out the poison, are infected, and become enlarged in consequence.

CHAPTER XXI.

CHANCRE.

Synonyms.—Initial lesion of syphilis; initial sclerosis; hard chancre.

Definition.—Chancre may be defined as the first manifestation of the syphilitic poison at the seat of its entrance into the body, and is due to the reaction on the part of the tissue against their invasion by the *Spirochæta pallida.*

The spirochætæ which are inoculated into an individual and cause the chancre are derived from the secretions and broken-down *detritus* formed in:—

(*a*) A chancre in another person.

(*b*) Mucous patches.

(*c*) Condylomata.

(*d*) Blood.

(*e*) Lymph.

(*f*) It was formerly thought that the *physiological secretions* did not contain the syphilitic virus, but recent investigations have shown that in exceptional cases they do contain the poison.

COURSE.

When the spirochætæ are first inoculated under the skin, they are too few in quantity to produce any symptoms. But the poison increases in amount, and, after three or four weeks have passed, the quantity is so great at the point of inoculation that the tissues react, and the chancre appears.

At this time the syphilitic virus is not distributed all through the body, but is localized to the tissues around the chancre and in the nearest lymphatic glands. Later on in the disease, the poison increases to an enormous extent, makes its way through the lymphatic system into the circulation, and the blood and lymph become surcharged with it.

The pus from a chancre, unlike that formed in a chancroid, has not the property of destroying the epidermis, and in order to produce a chancre it is necessary that the poison from a syphilitic lesion be introduced through an *abraded surface.*

This fact explains the cases in which a physician attends a syphilitic woman in confinement or a man has coitus with a woman who is affected with condylomata or a chancre, and, if an abrasion did not exist at the time of contact, inoculation does not occur.

Every case of syphilis contracted after birth must have a chancre for its point of departure, although it may be so slight as to be entirely overlooked.

TRANSMISSION OF CONTAGION.

The methods by which the contagion is transmitted may be classified as:—

(*a*) Direct.
(*b*) Indirect, or mediate.
(*c*) Inheritance.
(*d*) *Choc en retour,* or syphilis by conception.

By *direct contagion* we understand those methods in which the syphilis is inoculated by *personal contact,* such as coitus, kissing, surgical operations, a syphilitic child infecting its wet-nurse, or a healthy child acquiring syphilis by nursing from a syphilitic wet-nurse.

In *indirect,* or *mediate, contagion,* the disease is conveyed through the medium of some article which has been infected with the virus of syphilis, such as a spoon, pipe, cup, or cigar used by a person with mucous patches in the mouth; an instrument used for tattooing, dental, or surgical operations which has been used on a syphilitic individual and was not cleaned afterward, the tubes used in common by glass-blowers, or by means of underclothing or a bathing-suit which was stained with secretions from syphilitic lesions.

Choc en retour.—It was formerly supposed that a healthy woman having connection with a syphilitic man might escape infection with syphilis, but becomes pregnant, and later become infected with syphilis from her own child *in utero.*

Observations with the Wassermann reaction, however, have shown that this is not the case, but that the mother was syphilitic from the beginning, but showed no manifestations until after the child's birth.

Vaccination chancre in former years was not uncommon, and was caused by vaccinating with an instrument which had previously been used to vaccinate a syphilitic individual, and which was not afterward cleansed, but was used still contaminated with the syphilitic virus.

Chancres were also produced by vaccinating with dried lymph-crusts, which had been taken from vaccine-vessels produced in an individual who was also affected with syphilis at the same time.

At the present day animal-vaccine lymph, taken from the calf, is used exclusively, and as cattle are immune from syphilis, a chancre as the result of vaccination never occurs.

The **location of the chancre** depends, of course, upon the point at which the syphilitic virus is inoculated. The chancre appears

most frequently on the genitals, but may be on the lips, tongue, breast, or fingers. It begins as a papule or small tumor, which increases in size; the surface becomes eroded, or ulcerated, and furnishes a secretion which is not autoinoculable. The most characteristic feature of the chancre after the presence of *Spirochætæ pallida* is the **induration of the base,** which is caused by a deposit of small round cells in the tissues underlying the chancre, and also by inflammatory changes in the blood-vessels and lymphatics.

PATHOLOGY.

On microscopic examination of a section from a chancre, the findings are as follows:—

I. **A small round-celled infiltration of the skin and subcutaneous tissues** such as occurs in every inflammation. The latest investigation of the pathology of chancre shows that the *lymph-vessels* are primarily affected with an inflammation of their inner coats. The affection is particularly marked in the lymph-vessels which accompany the vasa vasorum. The *media* of the arteries are secondarily attacked and finally *endarteritis* occurs.

The changes in the arteries are more apparent than those in the lymphatics, and for that reason the alterations in the lymphatics were overlooked by the earlier observers.

II. **Changes in the Blood-vessels.**—The veins and arteries are both affected by the endarteritis, but the changes are more marked in the arteries. The inflammatory process begins in the vasa vasorum and extends from there to the accompanying vessels, attacking the adventitia, media, and ultimately the intima.

The endothelial cells of the inner coats of the vessels are swollen and the lumen is diminished. The middle coat is usually slightly thickened and infiltrated, but the important change is in the outer coat, which is the seat of an infiltration with small round cells.

III. **The Presence of Spirochætæ.**—Spirochætæ can be demonstrated in a chancre at its first appearance, but it is often difficult to find them after eight weeks have elapsed.

They exist in agglomerations in the tissues immediately surrounding the blood-vessels and in their walls, occasioning the endo- and periarteritis characteristic of the lesions. They are found in large numbers in the lymphatic spaces, in the lymph-channels leading from the primary lesion, and in the adjacent connective tissue, often at a remote point from the sore.

In consequence of all the changes described, the circulation of

blood is shut off, and coagulation necrosis, with sloughing of small areas of tissue supplied by the affected vessels, takes place.

It is desirable to understand clearly the pathological changes, since all syphilitic lesions—including chancre, papule, and gumma—are identical, and are due *primarily* to endarteritis, and *secondarily* to the accompanying round-celled infiltration.

In rare instances an *endolymphangitis* occurs, which obstructs the flow of lymph, and occasions a hard, boggy condition of the tissues, causing the so-called *indurative* or *sclerotic œdema.*

The **hardness** and **sclerosis** of chancre are not entirely accounted for by the microscopic findings, because the infiltrating cells are

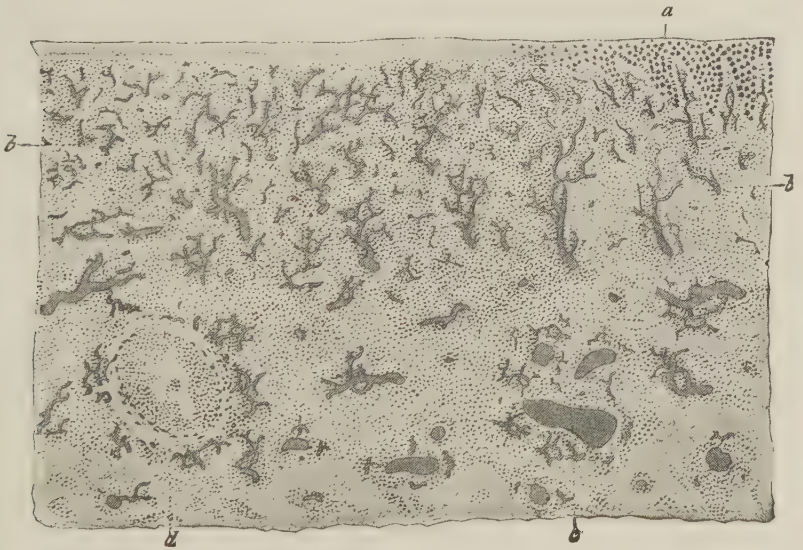


Fig. 256.—Section of a chancre (injected). *a,* rete mucosum; *b,* small round-celled infiltration with numerous injected blood-vessels; *c,* blood-vessels with endo- and peri- arteritis; *d,* lymphatics with adventitial and endovascular changes.

present in spots where no trace of hardness is perceptible to the touch.

Unna attempts to account for the hardness by supposing that a deposit of colloid material takes place around and between the bands of round-celled infiltration in the older parts, but that it is not formed as rapidly as the infiltration advances at the periphery.

The essential characteristics are always the same, but chancres vary considerably in outward appearance, as, for example:—

(*a*) In the amount of induration.

(*b*) In the depth of ulceration.

(*c*) In the amount of inflammation of the surrounding tissues.

Therefore chancre is grouped in several varieties.

The form of the chancre differs, depending upon the anatomical part upon which it is located, and also upon the course and situation of the blood-vessels.

When they run horizontally and near the surface, a thin, flat layer of infiltration occurs under the skin, which is called **parchment induration.** On the other hand, when the blood-vessels dip down deeply into the tissues, the induration is extensive and deep, and is called **Hunterian induration.**

For example: inside the prepuce, the parchment chancre often occurs; in the sulcus coronarius, a heavy mass of infiltration takes place, forming a Hunterian chancre; on the frenulum, a thick string occurs; and on the glans, a flat erosion.

VARIETIES.

I. *Dry papule,* made up of a very slight amount of induration.

II. *Hunterian chancre.* In this variety, which is named after John Hunter, a considerable amount of induration is present. Its central part is the seat of a coagulation necrosis, from the endarteritis which occludes the blood-vessels and causes a depression in the center, which is funnel-shaped, or like the crater of a volcano. The Hunterian chancre is the form most commonly met with.

III. *Parchment chancre.* This form is due to a superficial layer of infiltration lying immediately under the skin and widely spread out in the tissues. It feels like a piece of parchment on being pinched up between the fingers.

IV. *Indurative or sclerotic œdema.* This condition is produced by a combination of the usual endarteritis and small round-celled infiltration. It is accompanied by an inflammation of the lymphatic vessels or endolymphangitis, and usually occurs on the female genitals.

The circulation of the lymph is interfered with, and it transudes from the lymphatic vessels into the tissues. This combination of pathological changes gives rise to a boggy condition of the tissues, which is harder and more pronounced than in simple edema, and, on being pinched between a finger and thumb, a condition of *fibrosis* is felt. Indurative edema is a rare condition, but occurs more frequently on the female genitals than in men.

CHANCRE HEALS WITHOUT LEAVING A SCAR.

The ulceration and necrosis of the chancre take place at the expense of the newly formed tissue elements, rather than the normal

structures of the parts affected, and consequently no scar results. Chancroids always leave a scar after healing, because the ulceration spreads and destroys normal fixed cells of the part.

DURATION OF THE CHANCRE.

A chancre may heal in a few days or may remain unhealed for many months, especially if it is located under the prepuce and provided no mercurial treatment is given.

CHANCRE OF THE URETHRA.

Chancre situated *within* the urethra is a rare condition, but it does occur at times. It is usually located from one-half to one inch from the meatus, and the only symptom which it occasions is a thin discharge from the urethra, which may be easily mistaken for a gonorrhea. Examination, however, shows a hard, sclerotic mass surrounding the urethra under the skin, and the nearest lymphatic glands are also enlarged.

A knowledge of the fact that a chancre may be concealed within the urethra will sometimes be of service in explaining the cases of syphilis in which the patient admits having had a slight gonorrhea, but who denies that he ever had a chancre. In these instances the discharge from the chancre, issuing from the meatus, was mistaken for a urethritis.

DIAGNOSIS.

The discovery of the *Spirochæta pallida* as the cause of syphilis has placed in our hands a means of recognizing at once, in most cases, the nature of a suspicious sore, and it is now no longer necessary to follow the former practice and wait for the appearance of secondaries in order to make a diagnosis.

A microscopic examination of the serum obtained from the sore, preferably with the dark-field illumination, will show the living spirochætæ in full movement, and with a reasonable amount of practice they are easily differentiated from the other non-specific forms of spirochætæ, by their shape and the character of their movements. For this reason the examination by the dark-field illumination is to be preferred to the various staining methods, for with the latter the movements of the organisms are lost and differentiation is much more difficult.

When the method of examination for spirochæta is not available, as, for instance, in a chancroid where there is a suspicion of a mixed infection, or in a sore underneath a long prepuce, which renders it in-

accessible, or in remote places in the country, where the diagnostic opportunities of laboratories are not available, it is necessary to wait before making the diagnosis for secondary symptoms—*i.e.*, eruption, mucous patches, alopecia, fever, and headache—to confirm it, or we can make the diagnosis by confrontation.

Diagnosis by confrontation is made by examining the individual from whom the patient acquired the sore, in order to determine the presence or absence of syphilis.

The Wassermann reaction as a rule is not available so early in the disease; so that it cannot be depended upon for its assistance in making the diagnosis during the primary stage of syphilis.

The most reliable diagnostic points of chancre may be summarized as follows:—

I. The presence of *Spirochætæ pallida.*

II. Indolent painless swelling of the nearest lymphatic glands, which are polyganglionic, *i.e.*, arranged in a chain.

III. Induration of the base of the sore, which consists of a hard, cartilaginous induration, and feels like a foreign body imbedded in the tissues.

IV. History of the period of incubation, lasting about three weeks.

DIFFERENTIAL DIAGNOSIS BETWEEN CHANCRE AND CHANCROID.

CHANCRE.	CHANCROID.
Organism:	*Organism:*
Spirochæta pallida.	Ducrey's bacillus.
Incubation:	*Incubation:*
Three weeks.	Two to three days.
Commencement:	*Commencement:*
Begins as erosion or papule, which undergoes superficial ulceration.	Pustule or ulcer, and remains so.
Numbers:	*Numbers:*
Single generally. If multiple, so from beginning.	Multiple from beginning or becomes so by autoinoculation.
Edges:	*Edges:*
Level or sloping and adherent, giving "scooped-out appearance."	Abrupt and undermined.
Floor:	*Floor:*
Smooth, shining, red, or raw; covered with slight deposit.	Rough; worm-eaten; "wash leather" in appearance; yellow exudate.
Secretion:	*Secretion:*
Scanty; slightly purulent; not autoinoculable.	Abundant and purulent; autoinoculable.

Chancre.	Chancroid.
Progress:	*Progress:*
Slow.	Rapid.
Induration:	*Induration:*
Constantly present.	None or boggy.
Pain:	*Pain:*
Absent.	Painful and inflamed.
Bubo:	*Bubo:*
Constantly present. (See table in section on Bubo.)	Occurs in 1 out of 3 cases.
Rosary form.	Packet form.
Scar:	*Scar:*
Heals without scar.	Scar always remains.

The *Holländer hot-air apparatus* is useful in making a differential diagnosis between chancre and chancroid.

After being treated with the hot air, a chancroid can be easily removed with a sharp curette, while a chancre is so dense and firm that it cannot be scraped away.

Carcinoma may be differentiated from chancre by its slow growth and absence of constitutional symptoms. The inguinal glands in carcinoma enlarge later in the disease.

A gumma of the glans presents great difficulties in the way of diagnosis. The chief differential point, however, is that enlargement of the inguinal glands is not present, and the Wassermann reaction is positive in the case of gumma, while in the presence of a chancre it would be too early in the disease to get a positive Wassermann.

In the presence of a chancre with a phimotic foreskin, the chancre can be felt under the skin.

In women it is often difficult, or even impossible, to find the chancre among the folds of the labia.

When an extragenital chancre is present, the nearest lymphatic glands are irregular and are often in the form of "packets," the extreme enlargement being due to mixed infection.

PROGNOSIS.

It may be stated, in a general way, that the severity of the chancre bears some relation to the gravity of the secondary manifestations. When the chancre is benign, it is probable that the secondary lesions will be superficial and of a mild type, which can be explained in the following way: In a debilitated individual the tissues react more violently to the syphilitic poison, and consequently both chancre and secondaries are more severe, while, on the other hand, the tissues of a vigorous, well-

nourished person are in better condition to resist the action of the poison.

The type of chancre, however, is no indication as to the severity of tertiary lesions, and the severest tertiary accidents often follow a mild chancre.

This is sometimes, no doubt, due to the fact that treatment is often neglected or insufficient in mild cases.

TREATMENT OF CHANCRE.

No local treatment should be applied to the chancre until the examination for spirochætæ has been made, for calomel, iodoform, or any other antiseptic destroys the organisms and falsifies the diagnosis.

The cardinal rule in the treatment of chancre is to *avoid every form* of *irritation;* caustics, strong applications, or mechanical irritants should never be used.

When the chancre is located on the **integument,** a *moist dressing* should be used, consisting of a piece of cotton gauze, soaked in liquor aluminii acetatis, black wash (calomel and lime water), Thiersch's fluid, or bichloride solution 1 : 2000, and covered with a piece of gutta-percha tissue or oiled silk to prevent evaporation.

If the chancre is located **beneath the prepuce,** a simple dusting powder of calomel powder, which is covered with cotton, forms a suitable dressing that absorbs the discharge and prevents the open sore from being infected with pus-organisms, and when the chancre is ready for absorption, *mercurial plaster* is a useful application, as the local contact of the mercury with the chancre hastens its disappearance.

When much ulceration is present, iodoform may be used to advantage.

For a *chancre of the tonsil* the best remedy is a daily brushing with a 1 per cent. sublimate solution.

A primary lesion on the lip, while moist and secreting freely, responds well to applications of liquor aluminii acetatis, and, after it is dry and beginning to heal, an ointment of hydrarg. precip. albæ, 10 per cent. in vaselin, is useful; and later when only the induration is left, mercurial plaster may be used as an absorbent.

PROPHYLAXIS AGAINST SYPHILIS.

In the course of their experiments on monkeys Metchnikoff and Roux discovered that it was possible to neutralize the effects of an inoculation with spirochætæ by rubbing calomel ointment into the spot and so prevent the development of syphilis.

The experiment was afterward tried upon a man in the person of a medical student who offered himself for experimental purposes.

One hour after artificial inoculation upon the penis the abrasion was rubbed with calomel ointment for five minutes and syphilis did not develop.

The formula which the experimenters found to be the best is as follows:—

℞ Calomel ..... gr. xxxiij.
Vaselin, anhydrous ..... gr. x.
Lanolin ..... gr. lxvij.

Sig.: Rub in for five minutes.

In order to be effective the ointment must be used within eighteen hours after exposure.

Two other successful cases were reported in which men had coitus with syphilitic women, used the ointment, and prevented syphilis subsequently. Other experimenters, among them Neisser, made similar tests, but were unsuccessful in preventing the subsequent development of syphilis.

The method, however, has come into very general use in the United States Navy and some of the European armies, and it has resulted in materially reducing the number of syphilitic infections among the troops where it is employed.

A general knowledge and use of such a simple remedy should play an important part in reducing the spread of syphilis among the population.

ABORTION OF SYPHILIS AFTER INFECTION.

It is commonly held today among syphilographers that it is better to avoid giving mercury internally until the secondary symptoms of syphilis appear. It is impossible to abort the syphilis by the premature use of mercury, and the appearance of the eruption is only retarded.

It is believed by Ehrmann and others that the patient is rendered more liable to tertiary affections if mercury is given before the eruption appears, and while it is true that its internal administration causes the rapid absorption and disappearance of the chancre, if used too early in the disease it is detrimental, in the long run, to the patient.

The **early excision of the chancre**, before the appearance of the secondary symptoms, was widely recommended and practised a few years ago, upon the ground that the virus was strictly localized to the chancre and the tissues in its immediate vicinity, and that the poison might be entirely removed from the body by excising the sore.

Wolff, in Strasburg, excised the chancre in 500 cases, and in only 3 of them secondary symptoms did not appear.

In the 3 cases which did not develop syphilitic manifestations, the correctness of the diagnosis is always open to question, and at the present time the procedure of excising the chancre is regarded as useless in aborting syphilis.

The question has still further been studied by Neisser, who made experimental inoculations with the virus of syphilis on monkeys. He found that if the scarified area was extirpated eight hours after the inoculation it only prevented the development of the primary lesion, since in this short space of time the spirochætæ have invaded the surrounding tissues, and that previous to the development of the chancre the bone-marrow and spleen contained the organisms and the virus was inoculable into monkeys.

Although it has been found, both by animal experimentation and practical demonstration on human beings, that by excision of the chancre alone it is not possible to abort the syphilis, for the reason that the spirochætæ have already made their way into the lymphatics and the blood, consequently it is necessary not only to excise the primary sore, but to institute a general antisyphilitic treatment besides. The best drug to use for the early treatment is salvarsan. Mercury is less useful because it is not sufficiently effective in destroying the spirochætæ and the secondary lesions are only retarded in their development by the use of mercury.

The early treatment with salvarsan followed by mercury and, when possible, the excision of the sore is apparently a great advance, and occasionally is successful in aborting the syphilis.

If an intravenous injection of salvarsan is given as soon as microscopic examination of the secretion from the chancre shows the presence of spirochætæ, and is followed by an active course of mercurial treatment, preferably by calomel injections, in a few cases the syphilis has been cut short in the primary stage, as shown by an entire absence of secondary symptoms after months of observation and a permanent negative Wassermann reaction. This fortunate result may only be attained occasionally, but it is always worth trying, as no harm to the patient results from the procedure, if unsuccessful.

The chancre should also be excised when it is located in a situation where such a course is practicable.

CHAPTER XXII.

SECONDARY SYPHILIS.

PRODROMAL SYMPTOMS, OR PRODROMATA.

The spirochætæ and their toxins have the power, after they have increased in the body to a considerable amount, of destroying the red corpuscles, and on microscopic examination we find that the red corpuscles are diminished in number, with a decrease of hemoglobin, and that the number of leucocytes is increased. In consequence of these changes the skin and mucous membranes appear *pale* and *anemic*.

Fever is present in nearly every case. It is usually slight in well-nourished and strong individuals, but in debilitated subjects may reach 103° or 104° F.

Nocturnal Pains.—The shafts of the long bones, such as the tibia and ribs, and the vertex of the cranium are usually affected with pains which are more or less severe, and which have the peculiarity of *remitting through the day and coming on at night, and reach their maximum intensity about midnight.*

The pains are boring or tearing in character, and are called osteoscopic pains (bone-tearing).

The headache and neuralgia are due to a congestion and swelling of the periosteum lining the narrow canals of the bones through which nerves pass, and the pain is caused by pressure.

Jaundice occurs in a small proportion of cases, and, while its cause is not definitely ascertained, it is assumed to be due to *either* (*a*) pressure upon the common bile-duct, from the enlarged lymphatic glands lying in the abdomen, or (*b*) from congestion and swelling of the mucous membrane lining the common bile-duct, as a result of the disturbed circulation.

Albuminuria occurs occasionally. It is temporary in character and is due to congestion of the kidneys, and must not be confounded with the albuminuria which is sometimes an effect of the administration of mercury.

Erythema of the fauces is a most constant symptom, and appears as a generally diffused erythematous redness upon the pillars of the fauces and the pharynx.

The **spleen** is usually more or less enlarged, as occurs in all other infectious diseases.

All the symptoms described above under the term *prodromata* appear before the eruption and mucous patches, and all are occasioned by a disturbance in the local blood-supply, caused by the presence of spirochætæ in the tissues, which induces a condition of hyperemia or active congestion in the various organs affected.

SECONDARY LESIONS.

The mucous patch is one of the most constant and characteristic lesions of secondary syphilis. It makes its appearance about the same time that the eruption is observed. In the earliest stage the mucous patch appears as a pearly white round spot upon the mucous membrane of the mouth, entrance to the vagina, margin of the anus, or under the female breast. Its development may occur wherever the skin is thin and delicate and kept macerated by secretions.

As it is seen first, the mucous patch looks as though nitrate of silver had been brushed over the surface. After a little time, the infiltrated pellicle of the mucous membrane sloughs off, leaving a shallow, sharply defined, "punched-out" looking ulcer. This might be regarded as the second stage of the process, and is the form in which the mucous patch is most commonly seen.

The condyloma may be looked upon as the third stage in the development of the mucous patch, and is brought about by the active growth and proliferation upon the floor of the ulcer. The result is the formation of cauliflower-like granulations, which rise in little hillocks above the level of the surrounding healthy skin.

The secretion which is very abundantly furnished by mucous patches and condylomata is highly contagious, containing large numbers of spirochætæ, and is responsible for the transmission of most of the cases of syphilis.

An infiltration of the mucous membrane, followed by ulceration, often occurs upon the tonsils and uvula, and is known as *specific angina.*

It occurs particularly in smokers, and is very infectious.

Another condition which affects the mouth, particularly in late syphilis, consists in an infiltration of the tongue, with a thickening and cornification of its epidermis. It is termed *leucoplakia,* and is predisposed to by smoking.

It is a question whether it is a syphilitic manifestation or not.

ALOPECIA.

In many cases of early secondary syphilis, although not invariably, the hair falls out to a greater or less degree.

Pigmentary syphilide and alopecia. (Author's case, from King's County Hospital.) Patient was a female, aged 7 years, with acquired syphilis, and presented a diffuse, wide-spread dark pigmentation over body and neck, with areas of white, healthy skin scattered here and there through it. The alopecia occurred in the form of patches of baldness.

Alopecia occurs in various forms. It may be *complete,* in which case the hair of the head, eyebrows, and pubes may fall out entirely. The *usual* form, however, consists in a patchy baldness, the hair falling out in small patches of the size of a finger-nail. In some cases there is only a general thinning of the hair, without the formation of any distinct bald patches.

The cause of the local alopecia is from trophic disturbances of the spot, caused by the former presence of a syphilitic papule.

The general alopecia is due to a general trophic disturbance of the skin and nerves from the syphilitic dyscrasia.

The *prognosis* is good, and the hair always grows in again, unless an ulcerative process has taken place upon the scalp and destroyed the hair-follicles.

The nails are also affected by the general disturbances in nutrition. An inflammation about their roots often occurs, and furrows, running transversely across them, frequently form.

The toe-nails are more often affected than the finger-nails.

SKIN ERUPTIONS, OR SYPHILIDES.

All the eruptions on the skin, mucous membranes, and the pathological alterations of the viscera, bones, and periosteum in secondary and tertiary syphilis are due to the deposit and multiplication of the spirochætæ at the diseased point.

The spirochætæ are disseminated at first by spreading along the walls of the blood- and lymph- channels, as is seen in the enlargement of the lymphatic glands near the chancre, and later they enter the general blood-circulation, after which their spread is rapid and general, throughout the entire body.

After the first overwhelming of the body the spirochætæ disappear from the blood, and are only to be found in all the local lesions.

After the lesions have disappeared the spirochætæ still remain in the body, but so far as is known they have no particular predilection spot, although they are supposed to be seated in the glandular organs by preference.

It is also supposed that they remain in the organs which later manifest their continued presence by relapses, such as the skin, testicle, bones, periosteum, brain, and cord, which are the structures particularly liable to be attacked in recurrences.

Microscopically all the eruptions of syphilis are identical, and vary in outward appearance only because of the difference in the amount of cellular infiltration.

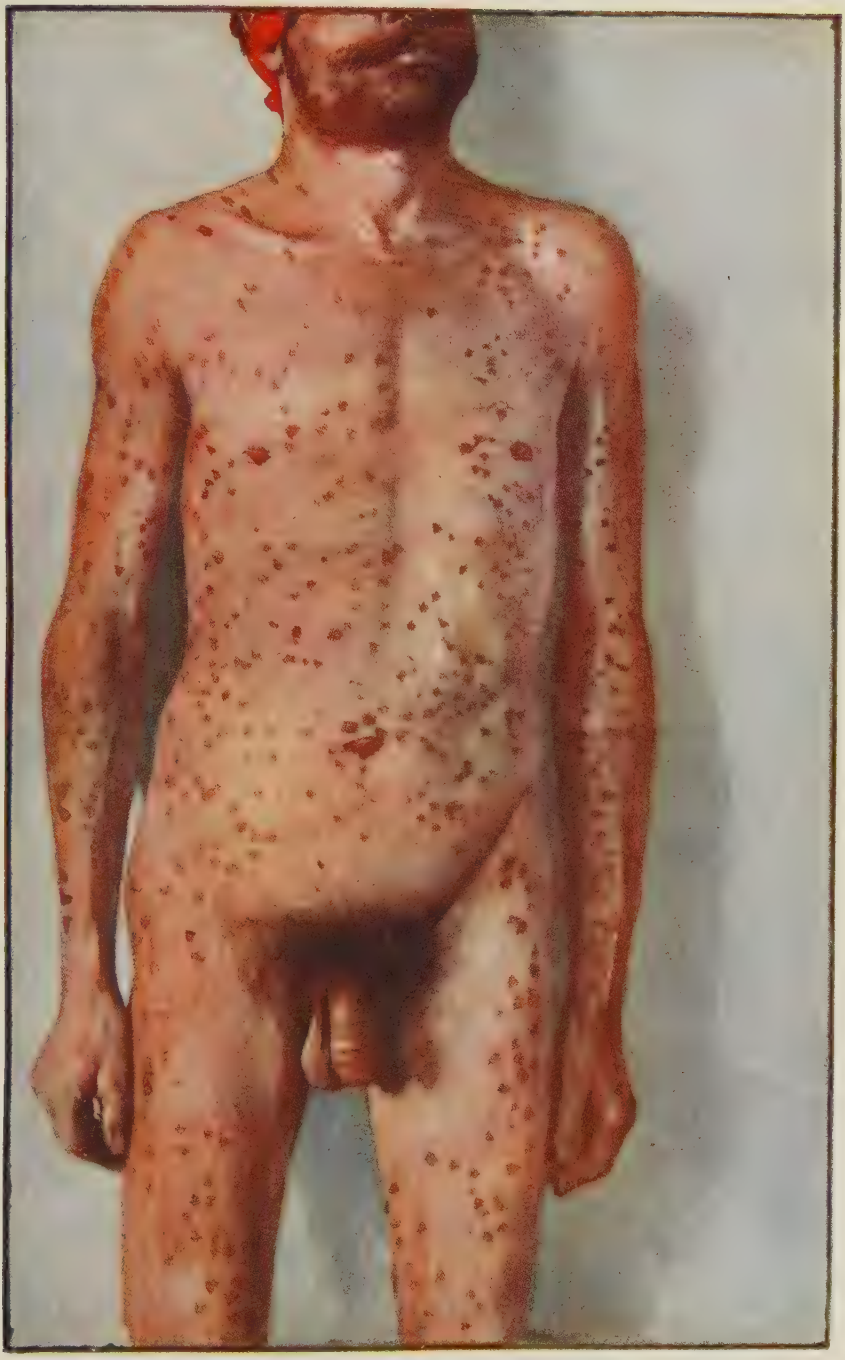
Microscopic examination shows that the alterations begin in the vasa vasorum and extend to the accompanying vessels, involving the outer, inner, and middle coats.

This is accompanied by an infiltration of round cells, which are emigrated lymphocytes, and if they remain without being absorbed become converted into spindle cells and then into connective tissue.

Fig. 257.—Condylomata of anus.

At times the changes of arteritis and cellular infiltration are so great that the circulation of the blood through the vessels is cut off, and the parts supplied become the seat of coagulation necrosis, and slough out.

All syphilitic tissue changes are inflammatory proliferations and new formations in connective tissue, and the alterations in the primary, secondary, and tertiary stages only differ in intensity, and in the third stage by a tendency to retrogressive changes and degeneration.



Maculopapular syphilide. A few papules are umbilicated and a few are beginning to scale on top. (Author's case, from Long Island College Hospital.)

The spirochætæ are found in the arterial coats to some extent, but chiefly in the vasa vasorum, thus accounting for the early hyperemic manifestations as well as the late arterial changes in tertiary syphilis.

Classification and Anatomy of Eruptions Occurring in the Secondary Period.—*I. Macular Syphilide.* Synonyms: Syphilitic erythema; syphilitic roseola.

The pathological change in the skin, which is the seat of a macular syphilide, consists in periarteritis and endarteritis, with an ex-

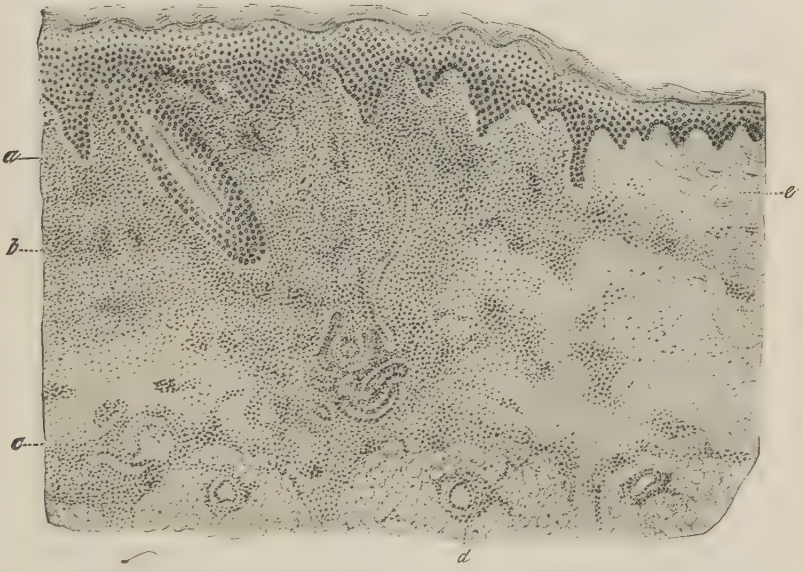


Fig. 258.—Section through a papular syphilide. *a, b, c,* small round-celled infiltration through corium and rete mucosum and around hair-follicles and sweat-gland; *d,* blood-vessels, with infiltration of the adventitia; *e,* normal cutis. (From "Die Syphilis und die Venerischen Krankheiten," von *Dr. Ernest Finger.*)

cess of blood in the capillaries; but while the round-celled infiltration has taken place in the tissues, it is so light in amount that it can only be detected by microscopic examination.

The spots may be large or small and are symmetrical in their location, being found upon the chest, abdomen, back, sides of the breast, and rump. The macular syphilide is very temporary in its duration, and disappears in a few days by a process of enlargement of the spots at the periphery, and their becoming pale in the center.

The **Herxheimer reaction** is a useful diagnostic measure.

It is made by injecting mercury hypodermically and it is also noted occasionally after the use of salvarsan. After the first injection of mercury a bright-red or copper-colored zone is noted around the old macules.

The presence of this zone is characteristic of syphilis, and is *diagnostic.*

In the presence of a macular syphilide, care should be taken to distinguish it from other skin eruptions, which resemble it closely, *i.e.,* measles, typhus, urticaria balsamica, pityriasis rosea, and tinea versicolor.

When the macular syphilide is marked in its extent, and a considerable amount of round-celled infiltration has been produced, it is readily perceptible, and forms nodules or small tumors, which are spoken of as the

II. Papular Syphilide.—The papules forming this variety of syphilide may be as large as a 10-cent piece or as small as a pin's head, and are accordingly classified as the *large* or *small papular syphilide.*

In certain cases the epidermis covering the papule scales off, but remains partly attached, and the syphilide is then spoken of as *papulo-squamous.*

If the center of the papule becomes necrotic and breaks down, a funnel-shaped depression is formed, which is filled with pus and covered over by a scale of epidermal covering. This variety is known as the *papulopustular syphilide.*

The papular syphilide disappears by absorption, but generally leaves pigmented spots at the former site of the papules, which ultimately disappear.

The *small papular syphilide* is not symmetrical in its localization, and sometimes itches, and on healing occasionally leaves scars. Care should be taken to differentiate it from lichen ruber planus, or lichen scrofulosorum.

The papules are sometimes grouped in circular form, localized around the mouth, nose, and genitalia. When so arranged, the lesion is termed the *circinate* or *annular syphilide,* and must be differentiated from herpes tonsurans or lichen ruber.

III. The Pustular Syphilide.—The pustular syphilide is formed from a pre-existing papule whose central part undergoes necrosis and, as a result of obliteration of the arterioles from endarteritis and periarteritis, sloughs and breaks down. The process is then complicated by the inoculation of pyogenic micro-organisms. These cause a suppuration of the central part of the papule, and the pus accumulates

underneath a covering of epidermis, which is raised up above it and prevents its escape.

The pustular syphilide only occurs in debilitated or cachectic individuals, and, as it may develop with a prodromal rise of temperature, may easily be mistaken for variola.

IV. The Pigmentary Syphilide.—This form of syphilide, sometimes termed *leucoderma syphilitica,* should not be confounded with the pigmentation which remains after the disappearance by absorption of a papule.

Fig. 259.—Large papular syphilide. (Courtesy of *Dr. Colby.*)

The pigmentary syphilide occurs as an independent eruption upon a spot which was not previously affected. It is occasioned by the endarteritis and periarteritis, which allow the red corpuscles of the blood to escape through the vessel-walls into the tissues. The hemoglobin of the escaped blood becomes dark brown in color, occasioning a pigmented appearance of the skin, and is ultimately absorbed, leaving the skin whiter in appearance than before.

The pigmentary syphilide occurs in *two forms:*—

(*a*) As dark-brown spots or patches of brown pigmented skin.

(*b*) As a diffuse, widespread, dark pigmentation, with areas of healthy white skin scattered here and there through it. In this form (*b*) absorption of the hemoglobin has taken place in certain areas of the pigmented patch, leaving white spots free from pigment.

The pigmentary syphilide appears on the neck and sides of the throat, and nine-tenths of all the cases occur in women. It begins in the third or fourth months of the disease, and remains in evidence from one-half to two years.

Distribution of Syphilides over the Body.—The portion of the skin attacked and the extent of the eruption depend upon the age of the syphilis.

The early eruptions which occur during the first six months are:—

(*a*) Superficially seated in the skin.

(*b*) Generally distributed over the body, appearing first upon the chest and abdomen, spreading subsequently to the palms and soles.

(*c*) The eruption is symmetrical, occurring alike on both sides of the body, and tends to arrange itself along the course of the connective-tissue bundles which lie under the skin (called lines of cleavage).

(*d*) The early eruptions generally disappear spontaneously by absorption.

Relapsing Syphilitic Eruptions.—The relapses occur after the first six months, and differ in the following particulars from the early eruptions:—

Distribution.—(*a*) While they may be distributed over the entire body, the relapsing eruptions are never so numerous as the early lesions.

(*b*) They do not follow the lines of cleavage, but are arranged in circles or segments of circles.

(*c*) The groups of lesions do not tend to arrange themselves symmetrically, as a rule, but have certain *spots of predilection,* such as the genitals and anus, the mucous membrane of the mouth, the palms and soles, the upper margin of the forehead near the hair, and the flexures of the joints.

(*d*) The later eruptions are less apt to be absorbed than the early lesions, but tend rather to break down and ulcerate.

Course of the Eruption.—Syphilides are temporary formations which grow and spread at the periphery, or outer edge, and after reaching a certain height *absorption* or *ulceration* takes place, beginning in the center.

In this way the *ring formation occurs.* The center, or oldest part, has been absorbed and has disappeared, leaving the most recently formed portion of eruption still present as a ring around the healed center.

Relapsing eruption in late secondary syphilis, showing general distribution, asymmetry of arrangement, and ring form of lesions. (Author's case, from Long Island College Hospital.)

Retrogressive Changes of Syphilides.—As stated above, the process of absorption always begins in the *center* of the lesion.

The *macular* syphilide disappears most readily, and, if pigmentation were formed, it is soon absorbed, leaving the skin *whiter* than normal.

In the *papule* the central part is absorbed, leaving a depression, which is filled with epidermal scales.

Fig. 260.—Malignant syphilis. Pustular eruption. (Author's case, from Polhemus Clinic.)

The pustule is formed from a papule, and has a crater-like depression in its center filled with pus; this dries up and forms a crust, and the surrounding ring of infiltration is removed by absorption.

The papule and pustule leave traces of their presence, as spots of pigmentation, which remain on the site of the original lesion for a long time.

If the pustule has caused much necrosis of the normal cutaneous elements, a cicatrix will be formed.

Symptoms of Syphilides.—I. Arrangement of the lesions. II. Polymorphism. III. Color. IV. Absence of burning and itching.

I. The arrangement has already been considered, and depends entirely on whether the syphilide is early or one of the late relapsing eruptions.

II. Polymorphism is the most valuable diagnostic sign of a syphilide, and pertains to both the early and late varieties of eruption. Polymorphism may be defined as *diverse as to form*, and is brought about in the following way: The eruption in syphilis never comes out all at once, but makes its appearance in successive crops. When the eruption is viewed, if it has lasted for some little time, it may be noticed that the *older* spots have undergone transformation, while in the *later* spots the changes are less marked. Hence we find present at the same time macules, papules, and pustules, and the lesions are all of different ages and various stages of development or retrogression.

III. Color. The color of syphilides is frequently compared to that of an old copper cent or of lean raw ham. The color is by no means pathognomonic, as it occurs in most inflammations of the skin which are chronic. It is occasioned by arteritis, which weakens the vessel-walls and allows the red corpuscles to pass out into the surrounding tissues. The hemoglobin loses its bright-red color and becomes brown.

IV. The absence of burning and itching is not invariable, but is usual, and is accounted for by the slow, chronic character of the development of the lesions.

Duration of Secondary Stage.—The secondary stage lasts a variable length of time, which may be from six to eighteen months, and may be set down as about one year, on the average.

In cases which follow a favorable course, *relapses* cease to occur and the disease appears to be at an end.

It is not possible to draw any distinct line of demarcation between the secondary and tertiary periods, for as the lesions continue to recur they gradually lose the distinguishing characteristics of secondary syphilis and become distinctly tertiary.

In the secondary stage the visible manifestations of the disease occur chiefly upon the skin and mucous membranes, and, while the viscera, eyes, and nervous system are occasionally attacked, they are not apt to be affected.

In the tertiary stage, however, the affections of the skin are trivial in comparison with the damage which may be wrought in other vital organs.

CHAPTER XXIII.

TERTIARY STAGE OF SYPHILIS.

It was formerly supposed that tertiary syphilis was not due to a living poison, but was more in the nature of a diathesis. Since the discovery and study of the spirochætæ it is known today that these organisms are still present in the body in the tertiary stage, although fewer in numbers than in the secondary stage, and not so generally disseminated, and that all the local lesions of the tertiary period are caused by the presence and irritation induced by the spirochætæ in the structures which become the seat of pathological alterations.

It was also the belief that the tertiary lesions were not contagious, and that is in practice actually the case, for the reason that the secretions from tertiary lesions contain only pus without spirochætæ.

The spirochætæ exist only in the hard edges of the tertiary lesions, and do not make their way into the discharge which flows from the open wound.

Animal experimentation, however, has shown that it is possible to transmit syphilis in the third stage by artificial inoculation, for Finger, Landsteiner, Neisser, and others have successfully inoculated monkeys with syphilis from tertiary lesions.

In one of Finger's cases the gummatous tissues were obtained from a man who had contracted syphilis some twelve years previously, and the conclusion must be drawn that as long as spirochætæ are present tertiary lesions, whether ulcerated or non-ulcerated, are contagious.

Individuals who are strong and well-nourished and who are systematically and carefully treated for a sufficient length of time rarely develop tertiary symptoms.

Marschalko, in a study of 673 cases, states that as a result of good treatment, tertiary lesions occurred in only 2.7 per cent.; in imperfectly treated cases they occurred in 19.3 per cent., and under insufficient treatment they developed in 23.9 per cent.

It is evident from these figures that tertiarism is almost wholly due to insufficient treatment or ignorant management.

Tertiary lesions do not occur before the second year (except in malignant syphilis), and when they do occur they appear in most cases from three to four years after infection, and from this time they occur progressively less in frequency, until about the tenth or twelfth year.

From the twelfth to the twentieth year their appearance is only exceptional, and after twenty years, extremely rare.

The lesions of tertiary syphilis occur first in point of frequency in the skin, next in the nervous system, the bones, mucous membranes, and viscera.

The great danger to the life or usefulness of the individual lies in the occurrence of the lesions of tertiary syphilis in the nervous system, attacking either the brain or spinal cord, and it is in order to prevent these accidents that the treatment should be most actively carried out, especially in the early secondary period of the disease.

A notable difference between the secondary and tertiary periods is, that while in secondary syphilis the lesions run a definite and regular course in their development and retrogression, with periods of latency between the eruptions, and are symmetrically diffused over the body, generally superficial, and have a tendency to spontaneous healing, the tertiary lesions act in a directly opposite manner in all these particulars, as will be seen by the accompanying table:—

Characteristics of Lesions of Skin and Mucous Membrane.—The characteristics of the syphilides in the tertiary period differ greatly from the secondaries, and may be summarized as follows:—

I. They attack a limited area.

II. They have a tendency to extend and cause destruction of tissue, with the formation of scar-tissue and its subsequent contraction.

III. They do not tend to spontaneous recovery, but rather break down and ulcerate.

IV. They extend deeply into the tissues.

Tertiary lesions, in whatever organ or structure of the body they may occur, are the direct result of chronic vascular lesions, and are commonly accompanied by the so-called gumma.

PATHOLOGY.

Arterial Changes.—In the tertiary period of syphilis, **arteritis** plays an important rôle. In the *secondary period* the inflammatory changes in the vessels are more apt to involve the *adventitia,* but in tertiary syphilis the *inner* coat is more liable to be attacked.

The presence of spirochætæ in the vasa vasorum and arterial coats causes a chronic inflammation of the vessel walls with an infiltration of small round cells between the *intima* and the *endothelial lining* of the artery, and this infiltration ultimately becomes organized into connective tissue. The contraction of the tissue thus formed causes a narrowing of the caliber of the artery, and, indeed, it may lead to the total closure

of its lumen, and the vessel becomes transformed into a solid string of connective tissue (endarteritis obliterans).

When the arterial wall is the seat of an inflammatory process which is very *circumscribed,* instead of its lumen becoming narrowed or obliterated, its walls may be stretched and dilated, and in this way small *miliary aneurisms* are formed.

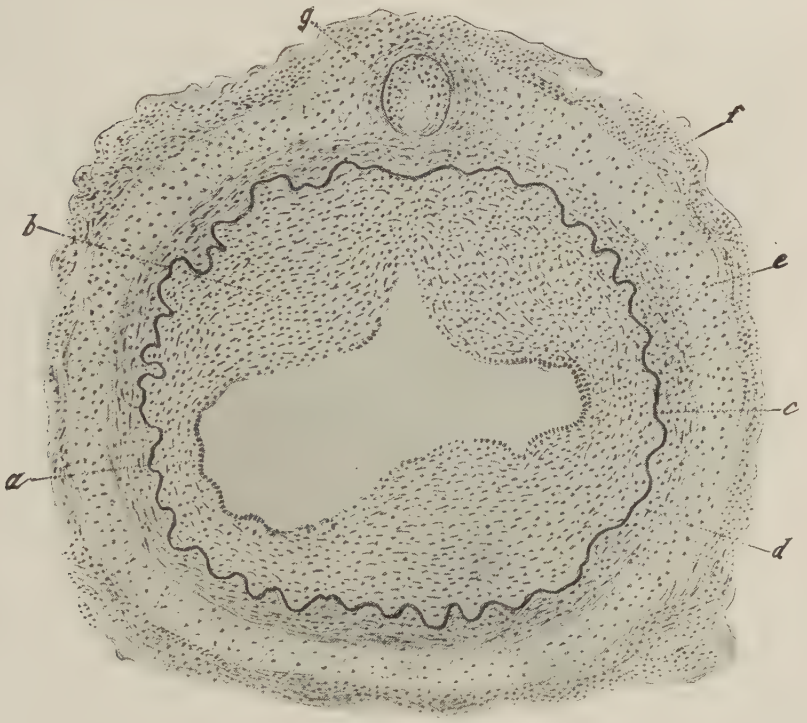


Fig. 261.—Endarteritis (artery from the fissure of Sylvius). *a,* swollen and infiltrated endothelial lining; *b,* new formation composed of connective tissue and small round-celled infiltration; *c,* membrana elastica; *d,* muscular coat; *e,* media; *f,* adventitia (all above layers infiltrated with small round cells); *g,* nutrient artery (vasa vasorum). (From "Die Syphilis und die Venerischen Krankheiten," von *Dr. Ernest Finger.*)

The process is not uncommon in the aorta, and the spirochætæ have been discovered in aneurism of the aorta.

Gummous arteritis is a rare affection, consisting in the formation of small gummata, which grow from the media and push upward, covered by the unchanged intima, into the lumen of the artery. The center of the gumma generally becomes cheesy and breaks down.

Obliterating endarteritis can also exist at the same point in the vessel, in addition to the gumma.

Gumma[1] is always preceded by and dependent upon the arteritis. It occurs especially in the skin, periosteum, meninges of the brain and cord, and the abdominal viscera, particularly the liver, spleen, and testicle.

The gumma consists of a circumscribed mass of new tissue, varying in size from a pin's head to a hen's egg, and is composed of a hyaline matrix, in which are imbedded small round cells, and occa-

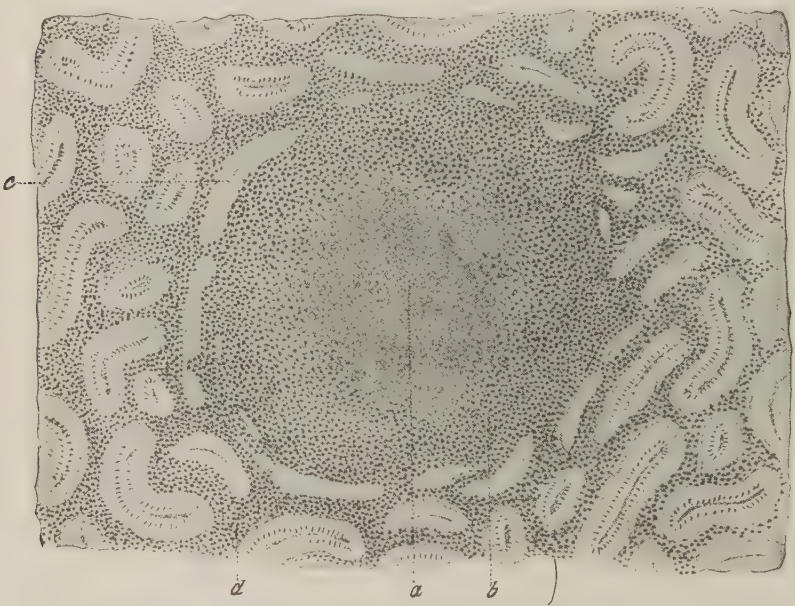


Fig. 262.—Gumma of the testicle. *a*, central portion seat of coagulation necrosis; *b*, peripheral zone formed by infiltration of small round cells; *c*, compressed tubuli seminiferi; *d*, interstitial small round-celled infiltration.

sionally giant cells. Small gummata may disappear by absorption, but in gummata of larger size the nutrition of the central parts of the tumor is cut off, by the pressure of the hyperplastic tissue on the blood-vessels, and by the accompanying endarteritis, and the center of the tumor undergoes coagulation necrosis.

[1] The name of infectious granulomata was given by Virchow to a class of diseases whose development does not pass beyond the stage of *formation of granulation tissue*, which is transitory in the character of its duration and ends by ulceration. In addition, it is nearly allied in its formation to the process of inflammation. The class of infectious granulomata includes syphilis, tuberculosis, leprosy, actinomycosis, mycosis fungoides, rhinoscleroma, and glanders.

As Schaudinn observed, the spirochætæ are found in the periphery of the necrotic areas, which accounts for the relative non-infectivity of the tertiary lesions.

In the very early stage of the gumma the spirochætæ exist in the walls of the blood-vessels and the surrounding cellular infiltration, but when the artery becomes obliterated and degeneration occurs the spirochætæ disappear.

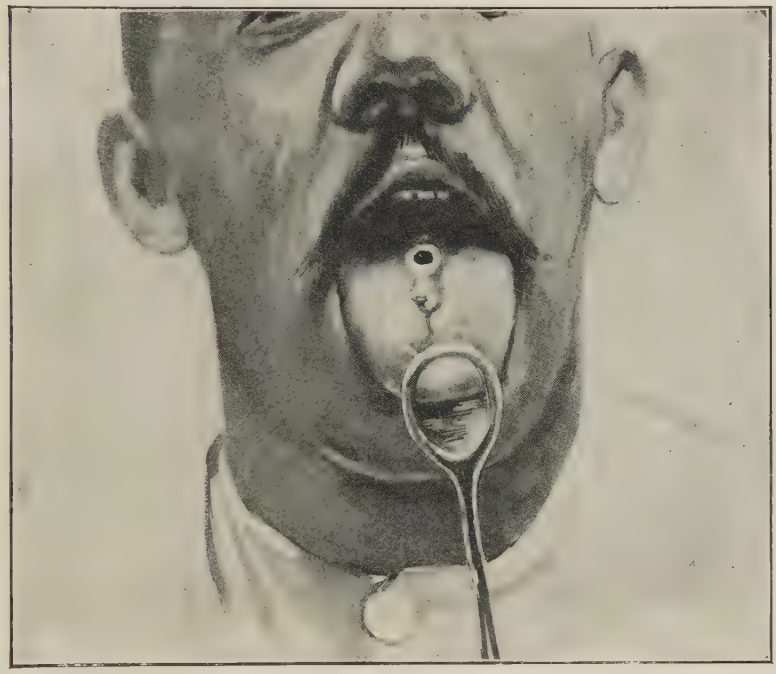


Fig. 263.—Gummata of the tongue. The one in the middle has undergone coagulation necrosis of its center. (Author's case, from Kings County Hospital.)

In this way the peripheral distribution of the spirochætæ is explained.

After a gumma has lasted for some time, it is found to be composed of an old central part, made up of fatty, cheesy, broken-down cells, and an outer zone which has been transformed into a fibrous connective-tissue envelope, surrounding the softened sloughing center.

A gumma may exist singly, or there may be several present, lying close together. The circumscribed form of gumma developing in the skin is termed a *syphilitic tubercle.*

CLASSIFICATION OF SKIN ERUPTIONS.

The eruptions which occur upon the skin in tertiary syphilis are all occasioned by the formation of gummata in the skin or subcutaneous connective tissue and their subsequent progress of ulceration, and are classified as follows:—

I. Gumma: (*a*) Of the skin. (*b*) Subcutaneous tissue.

II. Tubercular syphilide: (*a*) Dry or atrophic. (*b*) Ulcerative.

III. Rupial syphilide.

(*a*) **Gumma of the Skin.** (*b*) **Gumma of the Subcutaneous Tissues.**—Gumma of the subcutaneous tissues is the cause of the deep ulcerations commonly met with in tertiary syphilis. The skin lying

Fig. 264.—Ulcerating gumma of the ankle. (Author's case, from Kings County Hospital.)

above the gumma becomes attached to it by the inflammation, softens, and sloughs away, exposing to the air the cavity which was formed in the central part of the gumma by the coagulation necrosis of the new infiltrating cells. As the ulcers heal, a cicatrix is formed which dips down into the cavity of the gumma, and a depressed scar, attached firmly to the subcutaneous tissues, remains at that point.

The circumscribed form of gumma which develops in the skin is termed a syphilitic tubercle. This condition is entirely distinct from tuberculosis of the skin, which depends upon the tubercle bacillus, and in this instance the word tubercle means a little tuber, or small nodule. The tubercular syphilide appears in two forms:—

(*a*) **Dry, or atrophic, tubercular syphilide,** which is so called from the fact that it does not break down and undergo destruction, but tends to dry up and disappear by absorption.

It is this variety of syphilis which occasions the ringed form of eruption which comes on late in the course of the disease. (See plate.)

The atrophic tubercular syphilide often affects the palms of both hands in the secondary stage, or one hand in the tertiary, and is easily mistaken for palmar eczema.

When occurring about the face or on the body, the eruptions may be taken for psoriasis or lupus erythematosus.

(*b*) **The ulcerative form of tubercular syphilide** takes its name from the fact that, unlike the atrophic form, it is not absorbed, but breaks down and ulcerates, continually spreading farther at the edge and healing in the center. From this tendency to extend at the periphery and involve fresh areas of tissue it is sometimes termed the *scrpiginous syphilide.*

This eruption must be differentiated from lupus or epithelioma, and in doubtful cases it may be necessary to put the patient on anti-syphilitic medication in order to decide the question.

The rupial syphilide derives its name from the concentric rings of crusts which form the scab, resembling the rings of an oyster-shell. The formation of the rings occurs in this manner: A small gumma forms in the skin, ulcerates, and the ulcer is covered with a crust. The ulceration extends at the periphery; a ring of crust is formed over the new ulceration and lies underneath the first crust and, as it is larger in size, projects all around it. As the ulceration extends, other layers of crust are formed underneath the original ones, and each additional crust which forms is larger in diameter than the one preceding it and is not entirely covered, so that the edge is seen forming a ring around the crust above it.

The lesions above described are all deeply seated, involve the subcutaneous tissues, and result in more or less destruction of tissue, which is healed by the formation of contracting cicatrices.

SYPHILIS AND IRRITATION.

It was formerly difficult to account for the predilection which the lesions of the tertiary period seemed to show for certain structures. It is now known that after the first overwhelming of the system by the spirochætæ they are deposited in certain parts of the body, especially the brain, nervous system, tongue, skin, and periosteum, where they remain latent often for many years, until awakened to activity through irritation or excessive use of that part of the body.

Frequent examples of this fact have long been observed in practice, as, for instance, the effects of smoking, or the friction from broken teeth in causing sores in the mouth. Pressure contact, if oft repeated and prolonged,—as, for example, the pressure of the forearm upon a desk, in a clerk or bookkeeper,—predisposes to the appearance of an eruption upon the skin of the forearms. A slight blow or squeeze may induce the formation of gumma in the bones or testicles, and, as would naturally be expected, the bones which lie near the surface of the skin—such as the tibia, ribs, and skull—are more apt to be affected by periostitis than the bones which are abundantly covered by a thick cushion of muscle and fat.

On account of the presence of spirochætæ in the tissues, relapses affect the point of least resistance in the body. Thus, for instance, syphilis of the liver is more frequent in alcoholics than in abstemious persons, and syphilis is particularly liable to attack the brain and its meninges in individuals who are mentally active and are brain-workers. For the same reason a relapse of a syphilis which has been latent for some time is often induced by an attack of malnutrition brought on by want and privation.

MALIGNANT SYPHILIS.

Syphilis is said to be malignant when it pursues a rapid, destructive, and uncontrollable course from the outset, and it often occurs in individuals who are debilitated by tuberculosis, alcoholism, or bad nutrition and privation; but it may also occur in strong, well-nourished persons. Why syphilis should at times pursue a rapid and uncontrollable course, and at others be very mild and amenable to treatment, is not clearly understood.

One theory is, that a certain immunity to the disease has been acquired through heredity, which affords a partial protection.

Another theory is, that the lymphatic glands do not delay the entrance of the poison into the blood sufficiently to allow antibodies to form, and the body is overwhelmed rapidly with the poison, for it has been observed that there is but very slight swelling of the lymphatic glands in these cases.

The severity of malignant syphilis is increased from the fact that it resists ordinary treatment, for such patients do not stand the administration of mercury and iodide of potassium well.

Malignant syphilis usually begins with fever, and the brain becomes the seat of a gumma or an obliterating arteritis.

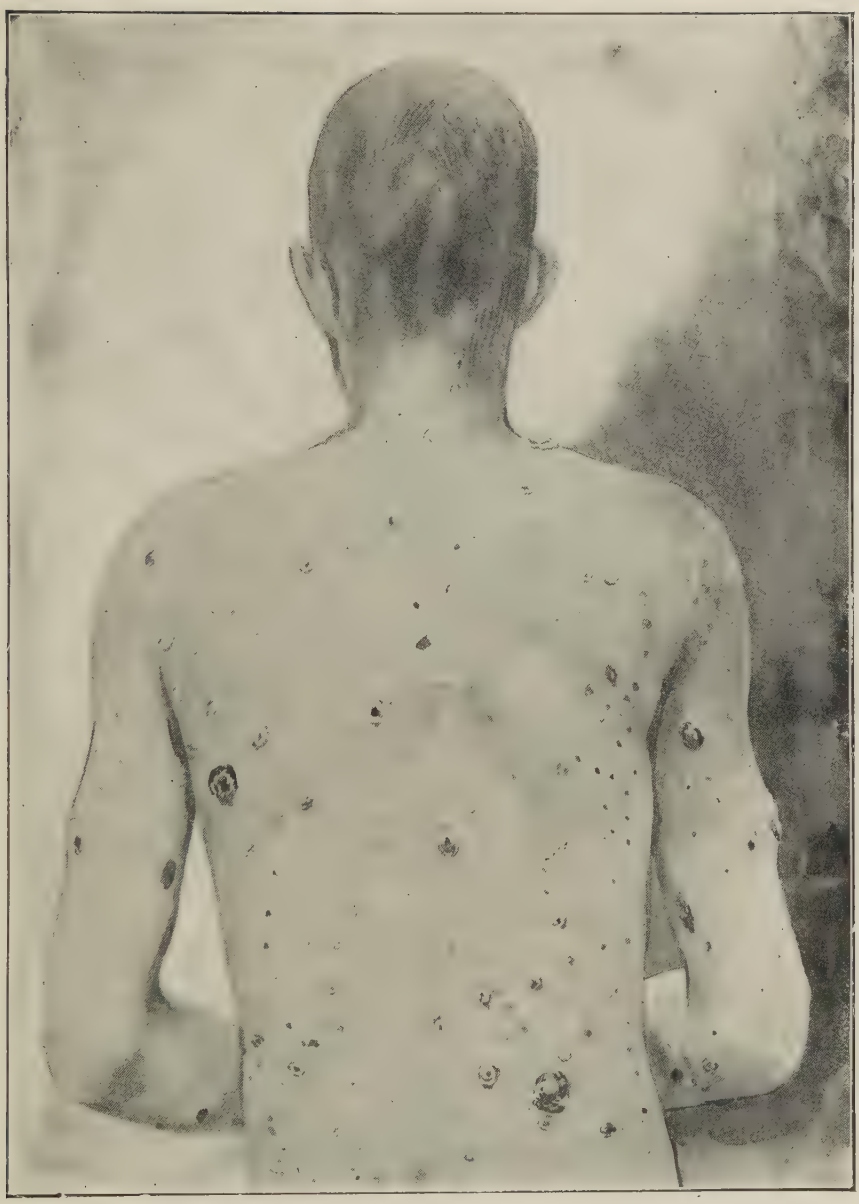


Fig. 265.—Pustular syphilide (malignant syphilis). (Author's case, from Kings County Hospital.)

The early lesions are generally distributed over the body, are pustular in character, break down, and cause extensive ulcerations. The anemia from the destruction of the red corpuscles is very marked, and the cachexia is strikingly evident. The subcutaneous fat is absorbed and the patient emaciates rapidly.

Sometimes the secondary stage is entirely lacking, and gumma develops prematurely, so that four or five months, or at most a year and a half, after infection the most extensive, widespread ulcerations, diffused over the entire body, may be present.

The ulcers often begin without any appreciable preliminary stage of infiltration. Death may result from destruction of some vital organ, or the prolonged suppuration of the ulcers may cause death from amyloid or fatty degeneration of the viscera, or general marasmus.

Many affections of the internal organs are caused directly by the endarteritis and arteriosclerosis of syphilis.

In recent times aortitis has been studied, and it has been found that a thickening of the media occurs, causing small folds on the inside of the aorta, from the formation of connective tissue.

The *heart muscle* may be attacked with a syphilitic myocarditis, often resulting in sudden death.

The *liver* may be the seat of a hepatitis resembling a cirrhosis from alcohol, and the kidneys are occasionally involved.

The *nerves* may be affected, particularly those lying in narrow bony canals.

In early syphilis they may be injured through pressure caused by a congestive swelling of the periosteal lining of the canal, and in the later periods, from the pressure from a periostitis.

Diseases of the nerves are often associated with and dependent upon periostitis of the skull.

Secondary epilepsy is caused in this way, viz., by pressure from a periostitis of the inner table of the skull, which may cause single muscle-groups to be affected.

In the tertiary period, the disturbance of the function of nerves may be due to the formation of gummata in their substance. When gummata are formed in the *sensory nerves* pain is caused at first, and later anesthesia, and when a *motor nerve* is affected paralysis occurs.

Impairment of the function of nerves, however, through a gummatous infiltration, is unusual, and it is generally caused by pressure.

The *brain* may be affected by an endarteritis obliterans, or a gumma, which is generally peripheral in location, and may soften or be absorbed.

For a fuller account of the diseases above mentioned, the reader is referred to the textbooks on surgery and internal medicine, and the dis-

eases of the nervous system, eye, and ear which depend upon syphilis for their causation are best studied in the special textbooks devoted to those subjects.

If the resistance of the system be enough to withstand the drain for two years, the virulence of the disease is exhausted, and the patient may live, but in a weak and debilitated condition of body.

In the foregoing sections we have considered the manifestations of

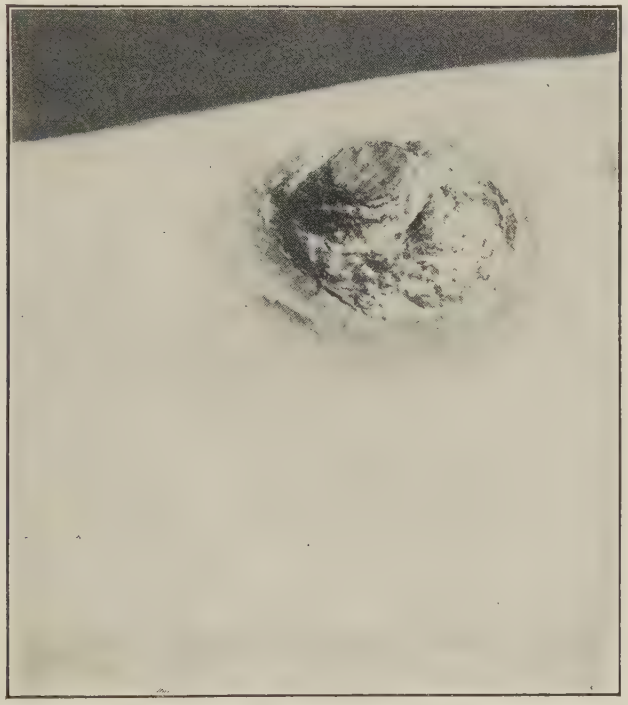


Fig. 266.—Rupial syphilide. (Author's case, from Polhemus Clinic.)

syphilis in the skin and mucous membranes only, but, as has already been indicated, the lesions of syphilis are not confined to any one structure.

The pathological processes of endarteritis and periarteritis, with their accompanying cellular infiltration of tissue and the resulting degenerative changes in the neighboring structures, as well as the gummatous infiltration occurring in the later period of syphilis, are liable to attack any organ in the body, and the symptoms resulting depend wholly upon the function of the organ attacked.

The periosteum of the bones may be affected by the formation of gummata or nodules, which occur by preference on the shafts of the long bones, especially the tibia, and the skull.

The bones may be attacked by a form of *rarification,* so that they fracture easily, or gummata may form in their substance, with resulting necrosis; or the periostitis may cause superficial caries with fistulous openings through the soft tissues. Osteomyelitis sometimes occurs.

The *muscles,* especially the biceps, may be affected by a chronic contraction, which clears up under the internal use of iodide of potassium.

The *joints* are sometimes the seat of pain, without any marked external anatomical change.

The sternoclavicular joint is most often affected in this manner.

More serious lesions, however, are apt to occur in the joints, leading to arthritis, hydrops, necrosis, formation of fistulæ, and permanent contractions.

IMMUNITY IN SYPHILIS.

Immunity may be defined as *the condition of body which resists the growth and pathogenesis of disease-producing germs.*

As to whether a certain degree of immunity acquired by heredity exists is still a matter of dispute, although it is a fact that when syphilis is transported into a community where it had been previously unknown its course is very virulent and severe.

It was formerly supposed that one attack of syphilis protected the individual against subsequent attacks and an immunity existed throughout the patient's life.

This has now been disproved and it is known today a second fresh infection with syphilis in the same individual is possible; the second infection can only occur after many years, and its course is milder than the original attack.

Another interesting fact which animal experimentation has brought out is the phenomenon of superinfection.

Superinfection in syphilis is the contraction of syphilis by an individual before he has recovered from the first attack and while the spirochætæ are still present in the body. It is only possible to reinoculate a syphilitic individual with syphilis during the time before the appearance of the chancre and for a period of from fifteen to thirty days after its appearance. From this time until after the patient is cured, that is, until the spirochætæ are all destroyed and the Wassermann reaction is permanently negative, the individual is no longer capable of being reinoculated with syphilis.

After this time his immunity disappears and he becomes again susceptible to infection.

A form of *passive immunity* which is sometimes observed occurs in children apparently healthy, and who remain so for some time, who are

born of syphilitic mothers. It is supposed that in these cases the fetus *in utero* may be partially immunized by the passage of dissolved substances (antibodies) across the placenta from the mother.

As to the cause of immunity we are still in the dark, but it is supposed that the condition is brought about either by phagocytosis or the formation of antibodies.

The latter theory is not fully established, but it is more generally accepted than any of the others. It is known that bacterial action and growth produce substances called *toxins,* which are poisonous. It is supposed that another set of chemical substances, called antibodies, is being formed at the same time, which either destroy the spirochætæ or exert some action on the tissues of the body which causes them to be insusceptible to the action of the micro-organisms or their toxins.

CHAPTER XXIV.

INHERITED SYPHILIS.

Before studying the effects of syphilis upon the child, it will be useful to consider the ways in which the poison is conveyed to the fetus *in utero,* and the effects which a syphilitic fetus may have upon the maternal organism.

MODES OF FETAL INFECTION.

Father and Mother both Syphilitic.—It is almost needless to say that when *both father and mother* are syphilitic at the time of conception, the fetus is almost invariably infected. The children suffer from a severe form of syphilis, and usually die.

Mother alone Syphilitic (Father being Healthy).—If the mother acquires her syphilis *before* conception, the child is almost sure to be infected, as it is nourished directly by the maternal blood containing the syphilitic virus. If the mother is infected with syphilis *after conception,* but during the pregnancy, we have two conditions to consider:—

(*a*) If the mother's infection has occurred in the *early months of pregnancy, before* the independent fetal circulation has been established, the fetus is usually infected with syphilis, because the fetus is nourished *directly* by the maternal blood containing the syphilitic virus.

(*b*) In the later months of pregnancy, however, the fetus has its own independent circulation. The villi of the placenta are interposed between the fetal and maternal circulation, and the nutrient material passes from the mother to the fetus, not by direct interchange of blood, but by *osmosis.*

If the mother acquires syphilis *after* the establishment of an independent fetal circulation, the villi of the placenta may filter out and prevent the virus from reaching the child; but, as the *antitoxins* are held in solution, they will pass through the membrane of the placental villi and exert an immunizing action upon the fetus. Hence we have **Profeta's law of immunity**: "Children may be born of syphilitic parents and remain healthy and present an immunity against syphilis which is either absolute or else modifies the syphilis so that it runs a very mild course."

Father alone Syphilitic (Mother being Healthy).—Under this head there are also two conditions to consider:—

(*a*) The spermatozoa may contain the virus and carry it to the ovum at the time of conception, and as a result the child is syphilitic. The

syphilis may cause the death of the fetus *in utero,* interference with development, or simple debility, or the child may be born syphilitic.

Infection of the fetus by the father is the most common form, but the syphilis resulting is less severe than in the other forms of infection, for the reason that if the mother remains healthy the fetus is nourished with healthy blood and the harmful effects of the syphilis are partly neutralized.

(*b*) The spermatozoa, however, do not always carry the virus of syphilis to the ovule, and the child often escapes infection and is born healthy.

The infectiousness of the spermatic fluid of a man with secondary syphilis was demonstrated by Finger and Landsteiner.

In one case the fluid was obtained from an uncomplicated case of secondary syphilis, and in their second from a case of syphilitic orchitis, in which infection was of three years' standing.

Influence of the Child's Syphilis as Exerted upon the Mother.—We may now consider the instances in which the *mother is free from syphilis,* but the child has been infected by the *father* at the time of conception. The effects which the child's syphilis cause in the mother must be divided into *three groups:*—

(*a*) In the first group, the mother remains entirely unaffected, and a condition of immunity is *not* established, so that the mother may acquire syphilis from her own child after its birth, or from other sources. These cases are extremely rare, but a few have been reported.

(*b*) The second group forms a large number of cases and comprises the instances in which the mother *is* infected with syphilis from her own child, during its term of gestation in the uterus. The name given to this mode of infection of the mother is *choc en retour,* or *syphilis* by *conception.* The syphilitic virus formed in the child passes over directly into the mother's blood, through the placental circulation.

Such at least was the explanation formerly, but the Wassermann reaction has shown that many of the mothers supposed to be infected by the fetus *in utero* were already syphilitic, but showed no manifestations of it.

(*c*) The third group includes the cases in which the mother shows no signs of syphilis either before or after the birth of the child.

It was formerly supposed that the mother acquired an immunity against infection by absorbing, through the placenta, antibodies which were formed in the syphilitic fetus, and the condition was formulated in **Colles's law,** which recites that "A syphilitic child cannot infect its own mother after its birth."

Since the discovery of the Wassermann reaction as a test for latent syphilis, the explanation of the freedom of the mother from symptoms has become more simple. It has now been demonstrated that 76 per cent. of mothers of congenitally syphilitic children have a positive Wassermann reaction, and that, instead of being immune to syphilis, they are already infected with it, but are in a period of latency and show no symptoms.

Length of Time After the Chancre at which Infection of the Fetus or Choc en Retour is Liable to Occur.—Syphilis is most liable to be communicated to the fetus or by *choc en retour,* during the secondary period and the first three or four years after the primary sore. As time passes, the intensity of the syphilis also diminishes, as is shown by the following table:—

Termination of Pregnancies in a Syphilitic Mother.—I. First pregnancy terminates in an *abortion.*

II. The next pregnancy results in the premature birth of a syphilitic child.

III. Then follows the birth of a full-term child, which has syphilitic manifestations.

IV. Next a child is born at full term, which subsequently develops manifestations of syphilis.

V. Finally, healthy, full-term children are born, which remain healthy and free from syphilis.

It is important to bear in mind that the inheritance of syphilis by the child can be favorably influenced or absolutely prevented by treating the syphilis of the parents, both before and after conception, with mercury.

As a result of the observations made in regard to inherited syphilis, the following principles can be applied practically:—

I. A man or woman with syphilis should not be allowed to marry until three or four years have elapsed since the original infection, and methodic treatment should be carried out during this period.

II. If a married man or woman acquires syphilis, he or she should be energetically treated, in order to lessen the danger of infection of the fetus in case pregnancy should occur.

III. A pregnant woman with syphilis should be energetically treated during the entire period of pregnancy.

IV. If a woman free from syphilis becomes pregnant, by a syphilitic man, she should be treated, to prevent the danger of *choc en retour.*

V. A syphilitic child should only nurse from its mother, and never be allowed to nurse from a wet-nurse.

VI. A child apparently healthy, although born of syphilitic parents, should never be allowed to nurse from a wet-nurse, until at least three months have elapsed without any symptoms of syphilis developing in the child.

SYPHILIS AND MARRIAGE.

The relation which the question of marriage bears to syphilis is an important one. While the spirochætæ are still present in the body, deposited in the hard edges of tertiary lesions and in other inaccessible situations, in the tertiary period, actual transmission of the disease to others does not occur after a couple of years, and it is an established clinical fact that a syphilitic person can only communicate the disease during the secondary stage; although animals have been artificially inoculated with spirochætæ from tertiary lesions.

In women, however, it is not uncommon to find syphilitic children born years after the mother's infection. In the light of modern knowledge the explanation of the transmission of syphilis to the fetus is simple, and is due to the persistence of the spirochætæ in the mother's tissues. It is also well ascertained that infection of the child is more likely to occur when it is procreated near the time of the mother's infection, and when she has had but little treatment.

For practical purposes a set of working rules may be formulated as follows:—

I. No one showing signs of active syphilis should be allowed to marry, even though more than four years have elapsed since the primary infection.

II. Marriage should never be sanctioned in men until at least three years have elapsed after infection, provided the patient has been systematically treated during that time: but four years is a safer time-limit, and patients should be advised to wait for that length of time.

III. Marriage should not be permitted until at least one year has passed during which *no* symptoms have appeared.

IV. Women should be advised to wait a longer time than four years, on account of the danger of communicating syphilis to the fetus *in utero*.

Of course, the object of treatment is to secure a permanently negative Wassermann reaction, but if in spite of intensive treatment the Wassermann reaction still remains positive it does not deter the patient from marrying, for, as above stated, tertiary lesions are not contagious in actual practice.

INHERITED SYPHILIS.

As already stated in the last section, the parental syphilis exerts a bad influence upon the fetus, unless a degree of immunity has been induced. In its most active stages the effect of the poison is to cause the termination of the pregnancy in an abortion; but as the syphilis grows older its virulence lessens, so that the next child is probably stillborn, and the following one may be born alive, but with the syphilitic taint.

Children which are stillborn are usually retained long enough in the uterus after death to become macerated. The epidermis is stripped off or raised up into large bullæ. The liquor amnii is discolored, brown, and foul-smelling. On examination of the infant's viscera, upon the autopsy-table, they are found to be the seat of the characteristic changes of syphilis.

Occasionally children are born of syphilitic parents who have all the manifestations of a florid syphilis upon them, but usually one or two weeks pass before the syphilis becomes visible. In appearance these children are usually ill developed, small, and of light weight. The skin is faded, and they look like little, shriveled old men.

If the parental syphilis is still older, the children may be born apparently healthy, and develop syphilitic manifestations later. The most common time for their appearance is within the first three months after birth and rarely later than the first six months.

Although children born of syphilitic parents may escape the inheritance of an active form of syphilis by reason of a certain acquired immunity, they may receive a **diathetic taint,** which does not make itself evident by any characteristic manifestations. These children have a feeble constitution and suffer from a general want of mental and bodily development which is particularly notable at the time of puberty, and epilepsy, idiocy, and hydrocephalus are today regarded as due to hereditary syphilis.

The children develop slowly, remain small, and are thin and anemic, and without the power of resistance against accidental disease. The intelligence is often deficient, and such instances are described as cases of **late hereditary syphilis.**

COURSE.

The course of inherited syphilis resembles that of the acquired disease, except that it does not begin from a chancre and that the lesions peculiar to the secondary and tertiary periods appear simultaneously.

When a child is born apparently well, but develops syphilis later, one of the most striking symptoms of the impending outbreak is the

nasal catarrh, causing **snuffles.** This is soon followed by an ulceration of the mucous membrane of the larynx, which causes a **hoarse cry.** Mucous patches occur about the skin of the mouth, which interfere with the child's nursing, and the nutrition suffers.

The **eruptions upon the skin** resemble those of acquired syphilis. A *macular eruption* often occurs upon the chest, and a *diffused erythematous redness,* resembling eczema in outward appearance, is often seen about the mouth, navel, and parts where the skin is liable to chafe against another apposing surface, such as in the groins, axillæ, or nates.

If the patient is not treated, and in severe cases, the eruption develops into *papules.* The soles of the feet and palms of the hands become the seat of copper-colored papules, which desquamate and are changed into deep *fissures.* The papules located about the mouth, anus, and genitals are apt to become transformed into luxuriant and vegetating **condylomata.**

An eruption which is unique, inasmuch as it does not occur in adults, but only in children, is *syphilitic pemphigus,* in which large *bullæ,* or blebs, form on the palms and soles, although it sometimes occurs over the entire body. Its formation is explained by the delicate character of the epidermis and the readiness with which serum collects underneath it and raises it from the derma, forming a vesicle or bulla.

Pemphigus is either present at birth or develops in the first week, and the children so affected usually die.

All the above-mentioned eruptions may exist at the same time, and the symptom of *polymorphism* is usually more marked in inherited than in acquired syphilis.

The viscera are affected in inherited syphilis even more frequently than in the acquired form. The *liver* is often the seat of a form of *cirrhosis* occasioned by its infiltration with newly formed connective tissue, or *gummata* may exist in various portions of the gland. The *pancreas* is affected in a similar way. The *lungs* may be the site of gummata, and as a consequence of periarteritis the framework of the alveoli becomes infiltrated with new cells in various areas, causing *white hepatization.*

A very characteristic feature of inherited syphilis is **osteochondritis,** which is considered by some authorities as pathognomonic. It consists in an overgrowth of the cartilage which is interposed between the epiphyses and the diaphyses of the long bones and skull. By palpation, the enlarged cartilage can be felt surrounding the bone like a collar. The ultimate course of the inflammation may end in suppuration and necrosis and, after extrusion of the dead bone, the injury is repaired by the abundant formation of new bony tissue,

called an **osteophyte.** Osteophytes occurring upon the skull give a peculiar "squared" shape to it.

The inflammation involving the cartilages often travels to the **joints,** and a serous or purulent synovitis occurs. **The teeth** of the second set are deformed by a vertical notching and peg shape of the central incisors.

The nervous system suffers as well, and epileptiform convulsions, headache, mental disturbances, idiocy, tabes, and progressive paralysis are frequently seen in syphilitic children.

Hemorrhagic syphilis exists at birth or else makes its appearance within the first month. It is a condition in which the blood is effused

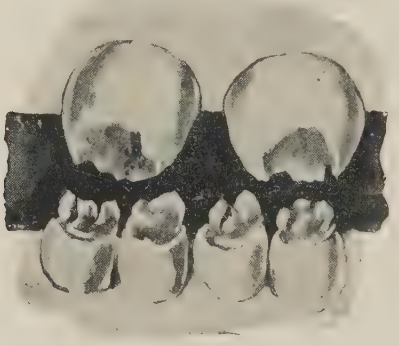


Fig. 267.—Hutchinson's teeth. These teeth have been recently cut, and the central notch is well outlined, but the thin and unprotected dentine has not yet crumbled away.

under the skin or mucous membranes, forming large purpuric spots. It is not infrequently met with, and is due to the endarteritis, which permits the escape of blood in greater or less quantities.

In all the lesions above described the spirochætæ are found, usually in great abundance, and the disease can be best described as an acute invasion of the entire system with these organisms.

RECOGNITION OF INHERITED TAINT.

There are certain points which are of use in making a diagnosis of inherited syphilis at an age advanced from infancy. The most reliable sign is the presence of **Hutchinson's teeth.** The central upper incisors of the second set are the most characteristically affected. The deformity consists in the *peg shape of the teeth* and the *vertical notching in their lower edges.* Jonathan Hutchinson considers them pathognomonic of inherited syphilis, and describes them as follows: "The

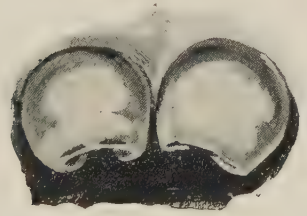
central incisors are short and narrow, with a broad vertical notch on their edges and their corners rounded off. Horizontal notches or furrows are often seen, but as a rule have nothing to do with syphilis."

The teeth as described are only in evidence until the twentieth or twenty-fifth year.

In the subjects of inherited syphilis the *skin* is thick, pasty, and opaque, or occasionally remarkably soft and silky. At the angles of the mouth may sometimes be noticed *linear scars,* radiating out into

Fig. 268.

Fig 269.



Figs. 268 and 269 show later stages of the process after the dentine has been destroyed. The characteristic peg shape, with the vertical central notch, is clearly shown.

the cheeks. The *bridge of the nose* is usually broad and low, and a want of firmness in the cartilaginous septum, which allows the nose to be shaken about too easily, is sometimes observed.

The *eyes* are liable to be affected, and the occurrence of a well-marked **interstitial keratitis** is regarded as *pathognomonic* of inherited syphilis. The *skull* is apt to be squared in shape and to show low protuberances in various parts. The *long bones* are often the seat of periosteal thickenings or nodes, and the phalanges and neighboring joints may be affected by a globular swelling, a form of periostitis or ostitis, to which the name *dactylitis* is given.

The *ears* are occasionally affected, and symmetrical deafness, which has occurred without discharge from the ears is said to be strong corroborative evidence of an inherited taint.

The three most typical symptoms have been grouped together under the name of **Hutchinson's triad,** and consist in (*a*) the interstitial keratitis, (*b*) deafness from disease of the labyrinth, and (*c*) Hutchinson's teeth.

The clinical signs are so well marked that in most cases diagnosis is easy, but in doubtful ones the Wassermann reaction will clear up the question with precision.

The *mortality* is greater in inherited syphilis when symptoms occur soon after birth, and the children affected with pemphigus nearly all die.

Intestinal diseases are a frequent cause of death, and intercurrent diseases are very apt to result fatally in childhood, so that it is unusual to see an old man with the stigmata of inherited syphilis.

TREATMENT.

It has been thought possible to treat an infant affected with syphilis by giving mercury to the mother and allowing the child to nurse from her breast. It was supposed that enough mercury would be eliminated in the milk to control the syphilis in the child. The quantity, however, eliminated in the milk is too small to be of very much avail, and we are obliged to give specific treatment in other ways.

In the case of a child two weeks or more of age, *calomel,* given internally, is found to be a satisfactory remedy. It may be given in doses of from $\frac{1}{10}$ to $\frac{1}{8}$ grain three times a day.

When the child is three months old, the dosage may be increased to $\frac{1}{6}$ grain, three times a day, and as the child grows older, $\frac{1}{4}$ or $\frac{1}{3}$ grain of calomel may be given three times a day.

The administration of the drug should be continued until the syphilitic manifestations have disappeared, and the green color of the feces which occurs may be disregarded.

Other preparations of mercury are also administered internally with good results, viz., the bichloride of mercury, grain $\frac{1}{96}$ to $\frac{1}{60}$, or hydrarg. cum creta, gr. j to vj, three times a day.

With children, as in the case of adults, inunctions are a very useful mode of giving mercury, as in this way digestion is not interfered with.

It is not necessary to rub the ointment all over the body, as in adults, but 30 grains of mercurial ointment, mixed with an equal quantity of lanolin to assist absorption, may be spread on the child's binder, which surrounds the abdomen, and allowed to remain in contact with the skin for two or three days. At the end of that time the ointment may be renewed.

If too much irritation is caused and an eczema follows, the inunction must be suspended and the drug given by the mouth.

In children who develop pemphigus in the first or second week, sublimate baths are effective. A wooden tub should be used, with from 15 to 30 grains of the salt dissolved in the water.

Treatment by *hypodermic injection* has been used by Immerwohl, of Roumania, successfully. He uses the following solution:—

℞ Corros. sublimati,
Sodii chloridi .....of each gr. iij.
Water ..... ♏clxxx.

Sig.: Each minim represents 1/60 grain, and an injection of from 2 to 4 minims is made once a week, continuing from four to six weeks.

As we have already found, in infantile syphilis the division into secondary and tertiary periods is not clearly defined, and the lesions peculiar to both periods often exist at the same time. On this account **iodide of potassium** is often called for by the appearance of tertiary lesions at an early date in the course of the disease. Iodide of potassium may be given in doses of gr. j three times a day, or it may be necessary to give it in much larger doses, if the lesions are severe.

The effects of salvarsan have been tried on infants, as the cases offer such a bad prognosis under the usual methods of mercurial treatment that almost any means which offers a hope of controlling the disease is justifiable.

The simplest means of using salvarsan and one which is free from danger is to administer it to the mother, and if the child nurses from the mother's breast the syphilis of the child is favorably affected, improvement occurring often within twenty-four hours. A complete cure, however, is not obtained and relapses follow.

If no improvement follows, or if the infant is not nursing, intravenous injection of salvarsan, which is a procedure attended with some danger, may be tried.

Döblin treated 6 infants with doses ranging between 0.03 and 0.06 gram in solution, and 4 died. Wechselmann treated 5, with 2 deaths.

In some of the cases clinical improvement of the symptoms occurred, but the infants died without any apparent cause a few days afterward.

It has been suggested that the death occurred from the enormous numbers of spirochætæ in these infants, and the consequent flooding of the system with their toxic products after the administration of salvarsan.

To avoid danger as much as possible a minimum dose, say of 0.01 gram intravenously, may be used, and the dose repeated when a

relapse occurs. Relapses after one dose are constant, and unless reinjection is practised death will follow.

In every case an active mercurial treatment should follow the administration of salvarsan.

It is eminently desirable to maintain the nutrition of a syphilitic child, and this can best be accomplished by allowing it to nurse from its own mother. The various forms of artificial feeding are less useful, and should only be resorted to when the mother's milk is insufficient.

Duration of Treatment.—No definite rules can be laid down for the length of time required for treatment. It is considered best to continue for at least two years, with occasional intermissions, but treatment should only be stopped after all manifestations have ceased.

The Wassermann reaction offers a guide to the amount of treatment here as well as in adults.

DIAGNOSIS OF SYPHILIS.

The question of diagnosis is an important one, both from the standpoint of therapeutics and also from the necessity of guarding other persons against a contagious disease. Of course, it is more difficult to make a diagnosis many years after infection than when the initial lesion, mucous patches, and eruptions are all present. It is always better to conduct the examination in a systematic manner, and begin by taking the **history of the case.**

We should inquire if the patient has suffered from: (*a*) a venereal sore with lumps in the groin; followed by (*b*) a rash upon the skin, (*c*) sore throat or sores in the mouth, (*d*) pains in the bones and skull which were worse at night, (*e*) sore eyes, and (*f*) in women the occurrence of abortion or stillbirths.

It is important to bear in mind that syphilis is not always acquired by venereal contact, and the initial lesion may not have been on the genital organs. We should also remember that the early manifestations may have been so slight, particularly in women, as not to have been noticed. It is also well to remember that in men there is a possibility of the chancre being located within the urethra, without causing any symptoms except a slight gleety discharge, which might be mistaken for a urethritis. After obtaining the history the examination of the patient should be proceeded with.

At the present time we have two great diagnostic aids in the presence of *Spirochætæ pallida* in the primary lesion and the Wassermann reaction in the secondary and tertiary period.

In the *primary stage* **Spirochætæ pallida** are always present in the chancre and can usually be found, but the Wassermann reaction is not dependable, as it generally does not occur until the development of the secondary period.

In the secondary stage the spirochætæ are always present, but they are impossible to find in skin lesions without making sections and staining, and in mucous patches are generally very difficult to discover and always mixed with other bacteria and spirillæ.

The Wassermann reaction, however, is present in 90 per cent. of the untreated cases. It must be remembered that a negative Wassermann is present in 10 per cent. of the cases, even though syphilis is present.

In the *periods of latency* where there are no manifestations to be discovered, the Wassermann is the only sign that can be made use of.

In the *tertiary period* the Wassermann is successful in from 55 per cent. to 70 per cent. of the cases where spirochætæ still exists in the body.

In all cases where syphilis is suspected and the Wassermann reaction is negative, it is desirable to make a few injections or inunctions of mercury, which will have the effect of changing the former negative reaction into a positive one, showing definitely the presence of spirochætæ in the body and demonstrating the existence of a syphilis which is only latent.

Roscher advises as provocative injections 3 sublimate, 2 salicylate, or 2 half injections of calomel, or 1 salvarsan of 0.02 gram.

If the Wassermann remains negative after these it is safe to wait two or three months and try again.

It should be remembered that the administration of mercury beforehand will cause a positive Wassermann reaction to become negative for a time, but not permanently; so that the mercurial test should only be used in the presence of a negative Wassermann to ascertain if by this maneuver it can be transformed into a positive one.

The *glandular enlargement,* which is such a valuable diagnostic sign, disappears after two years and is unavailable in general in the tertiary period, but in the secondary period the general glandular enlargement is of great diagnostic value. Of these, the paramammillar and postauricular glands are considered the most reliable sign; enlargement of the epitrochlear and postcervical glands is less to be depended upon, as they also enlarge from other causes.

The eruption, when present, is of great diagnostic value, but oftentimes a considerable knowledge of diseases of the skin is required to make a differential diagnosis between a syphilide and many eruptions which resemble it closely.

The *Herxheimer* reaction is useful in differentiating syphilitic eruptions from other inflammations of the skin. It is made by injecting mercury hypodermically. After the first injection of mercury, a bright-red or copper-colored zone is noted around the old macules.

The presence of this zone is characteristic of syphilis and is *diagnostic* (Roscher).

The mucous patches in the mouth, when present, together with the glandular enlargement, are the clinical manifestations most to be depended upon for making the diagnosis.

Late in the tertiary period the diagnosis often presents great difficulties. There are, however, certain **points for examination** which may throw some light on the nature of the case:—

The *skin* and *mucous membranes* should be examined for cicatrices. The *bones* and *testes* may show irregularities or swellings. The *eyes* often show decided changes. Local paralysis of an ocular muscle is a valuable diagnostic sign. Iritic adhesions may be present, or there may be changes in the deeper structures. B. Sachs regards the *action of the pupils* as a very important sign. The changes which occur in syphilitic cases, without previous demonstrable ocular disease, are as follows: I. Inequality of pupils. II. Unequal response to light in one pupil, but not in the other. III. Complete immobility to light and accommodation. IV. Departure from the circular form of the pupil without preceding iritis.

In doubtful cases the diagnosis is sometimes made by the effects of the administration of mercury and iodide of potassium. If the lesions improve, it is supposed that they were of syphilitic origin. This is a very uncertain and misleading method of trying to get at the truth, for the reason that mercury and iodide of potassium will often cause the absorption of newly formed inflammatory infiltration, irrespective of its cause. The results of an inflammation which was due to the irritation of any toxic agent in the blood—either uric acid, alcohol, or syphilis—will be absorbed under the use of mercury and iodide, although the infiltration due to syphilis disappears more quickly than the others. (See chapter on Inherited Syphilis.)

The Justus test in syphilis[1] is based upon the observation that a rapid reduction of hemoglobin takes place after an inunction with mercurial ointment.

In an untreated syphilis the hemoglobin is reduced in quantity from the destructive action of the virus upon the blood-corpuscles, and as the syphilis improves the hemoglobin is again restored.

[1] Justus, Virchow's Archiv, vol. cxl, page 91, 1895, and vol. cxlviii, page 533, 1877. Christian, University Medical Magazine, November, 1900.

If mercury is administered, preferably by inunction, a rapid reduction of the hemoglobin often occurs within twelve hours, and the percentage increases again in a few days. As treatment is continued, the hemoglobin is restored to a higher point than originally, and when it remains stationary the lesions begin to improve.

These changes only occur in active secondary syphilis, and not in the latent or tertiary forms of the disease, or in cases which have been under mercurial treatment for some length of time, and for that reason the reaction in quantity of the hemoglobin is only useful as a diagnostic measure in the early period of the disease.

The administration of mercury by the mouth is of no use, as its action is too slow, and it must therefore be given by rubbing in ʒj of blue ointment, or by injecting ʒj of a bichloride-of-mercury solution, hypodermically, and the observations are to be made from eight to twelve hours later.

The practical value of the test is still *sub judice*. In the case of venereal ulcers of doubtful origin it is of no value, and, while the hemoglobin reduction is obtained in a certain proportion of cases of active syphilis, it sometimes fails to appear, and also occurs in cases which are not syphilitic.

The Justus test and making the diagnosis by the effects of treatment are no longer used, as they have been entirely supplanted by the Wassermann reaction.

PROGNOSIS OF SYPHILIS.

The danger to life, in syphilis in the adult, depends upon the involvement of some vital organ by endarteritis or gummatous infiltration, or the development of tabes or general paresis; and this frequently occurs years after infection, when the syphilis is supposed to be extinct; but, as already stated, individuals who are strong and well nourished, and who are systematically and carefully treated for a sufficient length of time, rarely develop tertiary symptoms.

It is, however, impossible to tell the patient at the beginning of the disease whether it will run a mild or a severe course.

The prognosis, however, is better now since the discovery of salvarsan and the Wassermann test, as we can now discover a latent syphilis and use a sufficient amount of treatment to eradicate the disease.

We can now prevent the occurrence of tabes, paresis, and late tertiary manifestations, because a positive Wassermann reaction is a danger signal which may not be disregarded.

One negative Wassermann is not to be depended upon, because it is known that soon after treatment the Wassermann can become negative and later become positive again.

For this reason a negative Wassermann early in the disease has but little meaning, whereas late in the disease, after the cessation of all treatment, a negative Wassermann is of more value.

In general the Wassermann reaction becomes permanently negative after two or three years, but in certain cases the Wassermann still remains positive after many years.

If lesions are present on the tongue or skin in such cases, they need cause no anxiety, as active treatment may be instituted at once; but if the lesions are not visible and the Wassermann is positive, the lesions may be located in the heart or nervous system, and suddenly cause a disturbance which may be fatal.

The ultimate recovery of the patient depends upon the following factors, of which by far the most important is:—

I. The systematic thoroughness and length of time which the case is treated.

Marschalko, in a study of 673 cases, states that as a result of proper treatment tertiary lesions occurred in only 2.7 per cent.; in imperfectly treated cases they occurred in 19.3 per cent., and under insufficient treatment they developed in 23.9 per cent.

The next factor of prognostic value is:—

II. The constitution of the patient.

Any causes which tend to depress the general health—such as privation, bad hygienic surroundings, overwork, anxiety, loss of sleep, and particularly habits of alcoholic indulgence and pulmonary phthisis—are very unfavorable influences.

As in most other diseases, the extremes of life, that is, old persons and very young children, bear syphilis badly, and the death rate among children with inherited syphilis is high. Syphilis acquired, however, after birth, in the early years of childhood, runs a milder course than with adults. Women are believed to be less severely affected than men, and are thought to be less liable to syphilitic affections of the nervous system.

The appearance of tertiary lesions prematurely, *i.e.,* in the early months of the disease, is a very unfavorable prognostic sign.

Extragenital chancres—*i.e.,* those which are located on the finger, breast, lip, etc.—are more apt to be followed by a severe attack of syphilis than in cases where the chancre is located upon the genitals.

The last factor, or:—

III. The virulence of the poison, is a very uncertain quantity.

It is a fact often observed in former years and generations that syphilis in certain epidemics was particularly severe in its course, and fatal in its results. This was noted when syphilis was first observed in Europe, in the sixteenth century, and also in the Sandwich Islands, when syphilis was first introduced among the natives.

It is thought today, by many syphilographers, that the disease is assuming a milder type than in past years.

These facts have been accounted for by various theories: it is supposed that a certain amount of inherited immunity exists among European nations, which mitigates the course of the acquired disease, while when syphilis is introduced for the first time among a new people there is no inherited immunity among them to protect them from its force.

CHAPTER XXV.

THE WASSERMANN REACTION.[1]

The Wassermann reaction, which is an ingenious method of detecting the presence or absence of syphilitic antibody in a blood-serum, was first described by Wassermann, Neisser, and Bruck, in May, 1906, and two weeks later by Ladislaus Detre working independently. The theory of the reaction depends upon the Bordet-Gengou phenomenon of complement fixation or duration. To understand the reaction it is first necessary to be thoroughly familiar with the subject of hemolysis and the various factors on which it depends.

THE PHENOMENA OF HEMOLYSIS.

1. If the fresh serum of a normal rabbit at 37° C. is mixed in a test-tube with a suspension of washed sheep's red blood-corpuscles in isotonic salt solution, no change will occur, and the solution will remain opaque or, if allowed to stand many hours, the erythrocytes will fall to the bottom, leaving a clear, colorless solution above.

2. If instead of the serum of a normal rabbit we use the serum of a rabbit which has been immunized by intraperitoneal injections of washed sheep's blood-corpuscles at intervals of four or five days, it will be noticed that the mixture of immunized rabbit serum and suspension of sheep's blood-corpuscles at 37° C., at first opaque, later becomes a transparent, pinkish-red solution. This diffusion of hemoglobin from the sheep's red blood-corpuscles is termed hemolysis.

3. If the immunized rabbit serum is now heated to 55° C. for one-half hour and then mixed with the sheep's corpuscles as before, no hemolysis will occur.

If, however, we add some fresh normal guinea-pig serum, which by itself has no effect on the sheep's corpuscles, hemolysis will take place, showing that the hemolytic power of the heated serum has been restored.

From the above experiments it is evident that hemolysis by serum results from the joint action of two distinct substances which have been termed complement and amboceptor, or immune body.

[1] For the following chapter, on the Wassermann reaction, the author is indebted to his friend, Dr. Alfred Potter, Instructor in Dermatology in the Long Island College Hospital and Assistant Attending Dermatologist to Kings County Hospital and Polhemus Memorial Clinic.

The first is present in all fresh normal sera, and is destroyed by heating to 55° C. for one-half hour. The second is only produced by the introduction into an animal of an antigen, and is not destroyed by heating to 55° C.

An antigen is any substance which when introduced into an animal causes to be formed in the blood of that animal antibodies. The antigen in the above experiments was the sheep's blood-corpuscles.

These three substances—complement, amboceptor, and erythrocytes—together complete what is known as a hemolytic system. Hemolysis can only take place when all three are present.

The bacteriolytic system is very similar to the hemolytic system, and consists of (1) bacterium corresponding to the corpuscles in the hemolytic system and in both instances known as antigen, (2) a bacteriolytic amboceptor corresponding to the hemolytic amboceptor, and (3) complement similar in both systems. If the component parts of the bacteriolytic system are placed together in a test-tube at 37° C., union will take place just as in the hemolytic system, and the antigen or bacterium will be dissolved. The union of the three substances in the bacteriolytic system, however, is not visible to the naked eye. It cannot be proven, from the appearance of the tubes, whether or not the bacteria have been dissolved. The solution of the sheep's red blood-corpuscles, on the other hand, was most apparent, the mixture changing from an opaque to a clear-red color upon hemolysis. In the hemolytic system, therefore, there was an indicator to show that solution of the corpuscles had taken place, whereas no indicator was present in the bacteriolytic system.

The reaction discovered by Bordet and Gengou in 1901 utilizes the phenomenon of hemolysis to show that a union actually can occur between the three components of a bacteriolytic system. This reaction depends upon the principle of complement fixation and is performed as follows: The three elements composing the bacteriolytic system such as typhoid bacilli (bacteriolytic antigen) plus the inactivated serum of the patient to be tested for typhoid antibodies plus complement (fresh guinea-pig serum) in just enough quantity to complete the union are placed in a test-tube and incubated for one-half hour at 37° C. to allow them to unite. To the same tube are then added hemolytic amboceptor (immunized rabbit serum inactivated) and suspension of sheep's blood-corpuscles from the hemolytic system, but no more complement. The mixture is again placed in the incubator at 37° C. It will be noticed that there is present just enough complement to complete the union of one system, but not both.

Therefore, if union has taken place in the bacteriolytic system, showing that the patient's serum contained typhoid antibodies or amboceptor, the complement will be used up (fixed or deviated) and, there being none left to unite with the two parts of the hemolytic system, no hemolysis will occur and the solution will remain opaque. If, on the other hand, no union of the first three substances has occurred because the patient's serum contained no typhoid antibodies, the complement not being fixed will be available to unite with the two parts of the hemolytic system, and the sheep's blood-corpuscles will go into solution, as will be shown by the solution becoming a clear-red color.

The absence of hemolysis, therefore, denotes a positive reaction, and the occurrence of hemolysis denotes a negative one.

In 1906 Wassermann applied this principle of complement fixation in the diagnosis of syphilis. As it was impossible to obtain a culture of the *Spirochæta pallida* as antigen, Wassermann employed an extract of syphilitic tissue known to contain the organism in large numbers. The same principles as just described were then applied to syphilis, the extract of syphilitic tissue being substituted for the emulsion of typhoid bacilli and the serum of the patient to be tested for syphilis for the serum of the patient to be tested for typhoid.

It has since been demonstrated that other substances besides the extract of syphilitic tissue which are in no way related to syphilis, such as lecithin, various lipoid substances and salts, could be used equally well as antigen. While this proves that the reaction is not a true antigen antibody reaction as Wassermann originally believed, it does not in any way destroy the practical value of the test.

The five following substances are used in performing the Wassermann reaction:—

1. **Antigen.**—The antigen originally recommended by Wassermann was made by macerating the liver of a syphilitic fetus in 0.85 per cent. salt solution containing 0.5 per cent. phenol. The proportion used was 4 parts of fluid to 1 of tissue.

360 c.c. salt solution (0.85 per cent.).
100 grams liver.
40 c.c. phenol (5 per cent.).

This mixture is thoroughly shaken for twenty-four hours in a shaking machine. The fluid is then decanted off and kept in the ice-box in a dark, well-stoppered bottle. Most workers are agreed that watery extracts are likely to become anticomplementary by themselves on standing, or may lose their power to react with luetic sera. Marie, Levaditi,

and also Bruck use the watery extract in a dried powdered form. It is evaporated in vacuum and kept in sealed tubes. Bruck dissolves 1 gram of the dry extract in 1 c.c. of distilled water before use. The amount of watery extract used in the test is 0.1 to 0.2 c.c.

As stated before, Wassermann originally believed that the antigen was specific, but many investigators have since proven that alcoholic extracts of certain normal organs rich in lecithin, preparations of crude lecithin, and certain lipoid substances act equally as well as antigen, and they are now generally used for the reaction.

It is necessary not only that an antigen should deviate complement in the presence of a syphilitic serum, but also that it should give a minimum deviation with non-syphilitic serum.

The unit dose of antigen must be of such strength that one unit will completely inhibit hemolysis of 1 c.c. of a 5 per cent. suspension of sheep's red blood-corpuscles with 0.2 c.c. of known luetic serum plus 0.1 c.c. of fresh guinea-pig complement; provided double this dose does not interfere with complete hemolysis of sheep's erythrocytes when 0.2 c.c. of known normal serum is used plus 0.1 c.c. of fresh guinea-pig complement. From the above facts it is evident that the dose next to the largest hemolyzing dose is the strength of one unit, or 0.1 c.c. It is also apparent that 0.2 c.c., or a double dose, will not inhibit hemolysis when used with normal serum. A dose of antigen, therefore, should be used which does not bind complement even when twice the quantity of antigen is used.

2. **Amboceptor or Immune Body.**—Antisheep amboceptor is generally used. For its preparation a number of healthy rabbits are injected intraperitoneally every fourth or fifth day with increasing doses of washed sheep's blood-corpuscles. The sheep's blood is obtained from a slaughter-house, and is immediately defibrinated. The corpuscles are then washed thoroughly with a high-power centrifuge. After the first centrifugalization the clear serum is pipetted off and 0.95 per cent. salt solution is added and the process is repeated. After several washings, when the serum has been entirely removed, the original volume is replaced by isotonic salt solution; 2 c.c. of this fluid are used for the first injection of the rabbit. The second dose is increased to 4 c.c. of cells washed as previously described and brought to its original volume, and so on until four or five injections have been given. Nine or ten days after the last injection the rabbit is bled and the serum is allowed to separate. The serum when collected should be kept in a cold place. One unit of amboceptor should be determined by titrating against 1 c.c. of a 5 per cent. suspension of washed sheep's corpuscles, using 0.1 c.c. of guinea-pig complement. Two units are used in the test.

3. **Complement.**—This is obtained by bleeding a full-grown guinea-pig in a large, sterile Petri dish. The blood should be allowed to stand at room temperature for two or three hours, when the serum may be pipetted off; 0.1 c.c. of guinea-pig complement is the amount used in the test. The serum should not be more than two days old, and it should be kept in the ice-box when not in use.

4. **Sheep's Red Blood-corpuscle Suspension.**—One c.c. of 5 per cent. suspension of washed sheep's corpuscles is used in making the reaction. The blood should not be more than a few days old, and should be kept on ice. To make the suspension 1 c.c. of the sheep's blood-corpuscles, after being washed three times with 0.95 per cent. salt solution, is mixed with 20 c.c. of salt solution, making a 5 per cent. suspension of cells.

5. **Serum of the Patient to be Tested.**—Blood is drawn from a vein into a sterile receptacle and allowed to clot. The serum which is collected after clotting is inactivated by heating to 55° C. for one-half hour just before use. It is better to use the serum not later than twenty-four hours after collection, although it may be used forty-eight hours after if kept in the ice-box. In drawing the blood at least 5 c.c. should be obtained and preferably 10; 0.2 c.c. of inactivated serum is used in performing the test. The cerebrospinal fluid may also be used for making the test. When used, twice the quantity should be employed, and it should not be heated to 55° C., as it contains no hemolytic complement. It should also be free from blood.

TECHNIQUE OF THE WASSERMANN REACTION.

Take six clean test-tubes and place them in the rack in pairs, three in a row, one behind the other. In the first pair of tubes put 0.2 c.c. of inactivated serum from a known syphilitic, in each of the second pair of tubes 0.2 c.c. of the inactivated serum of the patient's blood to be tested, and in each of the third pair of tubes 0.2 c.c. of inactivated serum of a known normal blood.

The first and third tubes are used as controls.

Now to all the tubes is added 0.1 c.c. of fresh guinea-pig complement; 1 unit of antigen is next added to the first row of tubes only (one of each of the three pairs of tubes). The antigen is omitted from the back row of tubes to make sure that hemolysis will not be inhibited without the presence of antigen. Finally, all the tubes receive 3 c.c. of salt solution. The tubes are then shaken and incubated at 37° C. for one hour to allow the ingredients to unite. They are then removed and 2 units of amboceptor and 1 c.c. of the suspension of sheep's red blood-

corpuscles are added to all the tubes, and they are again incubated for two hours, when they should be removed and placed in an ice-box for twenty hours. The test is now complete and the reaction may be read. Complete hemolysis should have occurred in all of the rear tubes and also in the front tube of the normal serum. Complete inhibition of hemolysis should have occurred in the front tube containing the known syphilitic serum. If the front tube containing the serum of the patient's blood to be tested has completely hemolyzed, the reaction is negative. On the other hand, if complete inhibition of hemolysis is shown in this tube, the reaction is positive. It is apparent, therefore, that inhibition of hemolysis means a positive reaction, which, according to its degree of intensity, may be classed as strong positive, positive, or weak positive. Complete hemolysis means a negative reaction.

The Wassermann reaction is complicated and requires not only a great deal of training for the perfection of the technique, but a considerable expenditure of time for its performance. It is practically impossible unless one has access to a well-equipped biological laboratory. Many attempts have been made to simplify the reaction. The most successful modifications seems to be the **Noguchi reaction**, originated by Dr. Hideyo Noguchi, of the Rockefeller Institute of New York.

The Noguchi modification, like the original Wassermann reaction, depends upon the principle of deviation of complement. Unlike Wassermann, however, he uses an antihuman hemolytic amboceptor, thereby eliminating the sheep's blood-corpuscles. The guinea-pig serum is used as complement, as in the other test. No inactivation of the serum is necessary, as human complement in the dose used in his test, 1 drop, is not active against human corpuscles, when 2 units of amboceptor are used. As indicator, the corpuscles of the patient to be tested or normal blood are used. To still further simplify the procedure the antigen and amboceptor have been concentrated, dried, and impregnated in filter-paper, tiny squares of which represent measured amounts of the impregnated substance.

The Noguchi test is performed as follows:—

The same number of tubes arranged in the same manner as for the Wassermann reaction are used. To the first pair of tubes is added 1 drop of serum from a capillary pipette from the blood of a known syphilitic. To the second pair of tubes is added 1 drop of serum from the patient's blood to be tested, and to each of the third pair of tubes 1 drop of normal blood-serum; 0.04 c.c. of fresh guinea-pig serum is now added to all the tubes. Thirdly, all the tubes receive 1 c.c. of the suspension of human red blood-corpuscles in the proportion of 1 drop of blood to 4 c.c. of saline. One square of paper representing antigen is

finally added to the front row of tubes only, when the tubes are well shaken and placed in the incubator for one hour at 37° C., or in a water bath at the same temperature for one-half hour. The tubes are then removed and one square of paper representing amboceptor is added to all the tubes, and they are again shaken and incubated for two hours, when they may be allowed to stand for two hours at room temperature and the reaction read.

If the Noguchi modification were only more simple in its performance than the Wassermann reaction, much could be said in its favor. That it is also more delicate in the detection of syphilitic antibodies is the contention not only of its author, but of many other investigators. The source of inaccuracy in the Wassermann test, according to Noguchi, is the presence in the patient's serum of an unknown amount of natural hemolytic amboceptor against sheep's corpuscles, being as high at times as 20 units.

CLINICAL APPLICATION OF THE WASSERMANN REACTION.

The diagnostic value of the Wassermann test depends upon the fact that the antibody contained in the serum causing the reaction is specific, occurring only in the serum of luetics. Except in rare instances this has been found to be true. Positive reactions have been obtained in frambesia, relapsing fever, trypanosome infections, and tubercular leprosy. It is also found positive after veronal, morphine, scopolamine, ether narcosis (Wolfsohn), and frequently in sera obtained just before or after death. Therefore, while it is true that a positive reaction is obtained in a few diseases and conditions other than syphilis, the differential diagnosis between syphilis and those diseases should not be difficult, at least in this country, and the reaction may be said to be practically specific. A negative reaction, on the other hand, cannot be accepted as proof that the disease does not exist, as negative findings have been obtained in a small percentage of active cases of syphilis. If, however, a negative reaction is repeatedly obtained after several trials made at intervals, it is almost positive proof that the disease is not present. The reaction appears from two to four weeks after the appearance of the initial lesion, and persists throughout all stages of the disease unless influenced by treatment. A positive reaction has been obtained forty or fifty years after infection. Quite often a positive reaction may be obtained before the appearance of secondary symptoms. In the active stages of the disease 95 per cent. of cases give a positive Wassermann reaction and at least 75 per cent. of tertiary cases. In latent cases of the disease, while the con-

tinued existence of the spirochætæ renders the patients liable to outbreaks of symptoms at any time, nevertheless, the organism is often in a dormant state, which makes the appearance of symptoms less likely. In these latent cases a positive reaction is obtained in 50 per cent. of the cases. It is in this class of cases that the Wassermann reaction is of special value, as these patients are often apparently healthy and may give no history of ever having had the disease. Oftentimes a negative reaction in these latent cases may be transformed into a positive reaction by the administration of a short course of mercury or salvarsan.

DIAGNOSTIC VALUE OF THE SERUM REACTION.

From our present knowledge it is evident that a positive Wassermann reaction is of inestimable value in differentiating atypical lesions of all stages of lues. Indefinite symptoms not suspected of being syphilitic have been proven to have been so by the positive Wassermann reaction and the subsequent cure under antisyphilitic treatment. The Wassermann reaction, unlike the therapeutic test, enables us to establish the nature of the condition directly and not by inference. It has proved also that primary sores may show all gradations from the typical indurated chancre to a slight abrasion.

The law of Colles, that the mother of a syphilitic child is immune to the disease, and also that of Profeta, according to which the child of a syphilitic mother is immune to syphilis, have both been disproven by the Wassermann reaction. A positive Wassermann reaction is often obtained in children with none of the characteristic inherited stigmata of syphilis, and showing almost no symptoms except perhaps anemia and nervousness.

Nearly 90 per cent. of tabetic patients give a positive reaction. In dementia paralytica the reaction is always positive, and in congenital syphilis the reaction is generally stronger than in other forms. In cases of aneurism of the aorta and in the earlier history of arteriosclerosis and aortic insufficiency the reaction is generally positive. While a positive reaction is absolute proof that living spirochætæ are present in the patient's body, a negative reaction, even though there is no fault in the technique in performing the test, does not definitely exclude syphilis. It is quite certain, however, that repeated negative reactions will not be obtained if active syphilis is present.

In the primary stage of the disease the Wassermann reaction should be supplementary to the demonstration of the spirochætæ by the microscope as a method of diagnosis. In the differential diag-

nosis of tertiary lesions and latent lues it must be remembered that, while a positive reaction always means the presence of syphilis, it does not necessarily follow that the lesion in question is syphilitic. For example, it is quite a frequent occurrence to have an epithelioma develop on a gumma of the tongue, in which case a positive reaction would show that the patient had syphilis, but a histological examination would be necessary to establish the diagnosis of epithelioma.

No matter at what period of the disease a positive reaction is obtained, it is evidence that the disease is active or at least that there exist living spirochætæ, and that the patient is in need of further treatment to prevent the occurrence of symptoms or relapses. In the event of a positive reaction appearing persistently in spite of energetic treatment, the prognosis is bad and these cases generally terminate in dementia paralytica.

EFFECT OF TREATMENT ON THE REACTION.

In the early studies of the serum reaction it was noted that cases which had received treatment gave a much lower percentage of positive reactions than untreated cases. Citron, who was the first to make this observation, after a careful study of his results, propounded the two following laws: 1. The longer the syphilitic virus has worked in the body and the oftener it has caused recurrences, the more constant and stronger is the antibody content of the serum. 2. The earlier the mercurial treatment is started, the longer it is continued, the more frequently it is repeated, the more efficient the method of application, the less is the antibody content and the more frequent the reaction is negative.

The general result of treatment, according to Citron, is that energetic mercurialization begun as early as possible after infection and long continued restores the serum to its normal condition. The greater length of time allowed to elapse without treatment after inoculation, the more difficult it is to restore the serum to normal. While a positive reaction may become negative after several months of active treatment, this is not an indication that treatment may be discontinued, but simply that the disease is under control and responding to treatment. If, on the other hand, the reaction remains positive in spite of the treatment, it is an indication that the treatment is not efficient and the method of its application should be changed or it should be supplemented by other remedies. Latent cases of syphilis showing no manifest symptoms, but giving a positive Wassermann reaction, should receive further treatment, as they are in danger at any time of relapses.

The Wassermann reaction is the surest test at our disposal as to

whether a patient after a thorough course of treatment is cured, and it should be used to control the treatment of all cases of syphilis. Cases under treatment should be examined every three or four months. After several years' treatment, if the reaction is positive, treatment should be continued. If negative, treatment may be discontinued and the patient's blood examined every four to six months and finally every year. Treatment should be resumed immediately upon the reappearance of a positive reaction.

EFFECT OF SALVARSAN ON THE WASSERMANN REACTION.

The effect of salvarsan on the serum reaction, as reported by many different observers, differs widely. The reaction does not always change from positive to negative, and the time of such change when it does occur varies within very wide limits. My experience has been to note a change from a positive to a negative reaction on an average of four weeks after injection of the drug. Most of the cases which I have been able to follow up which have received no treatment after the one injection of salvarsan have had a return of the positive reaction in from three to five months. One case of chancre of the lip, treated before the appearance of any of the secondary symptoms, has remained negative without further treatment for over a year. On the other hand, a case of syphilitic glossitis of eight years' standing, which had been receiving treatment continually all that time with little effect, was cured clinically three weeks after one injection of salvarsan, but has never yet had a negative Wassermann reaction seventeen months after the injection.

The experience of most observers in regard to the effect of salvarsan on the Wassermann reaction is similar. In some cases there are decided changes; in equally as many others they are doubtful or absent. It is claimed by some observers that, since larger doses are being used, changes from positive to negative are more frequent and appear earlier. Certainly the effect of salvarsan upon the Wassermann reaction is much less favorable than upon the clinical manifestations of syphilis.

CHAPTER XXVI.

TREATMENT OF SYPHILIS.

As syphilis is a general and constitutional disease, dependent upon a specific poison, the *Spirochæta pallida,* it is necessary to introduce a remedy into the circulation which will neutralize it and render it inert and harmless. The drugs which are the mainstay in the treatment of syphilis are mercury, iodide of potassium, and salvarsan.

The mode of action of mercury is still somewhat uncertain, but it is known to have direct action upon the spirochætæ, destroying them, and also in softening the deposits in which they lie encapsulated and dormant, causing them to be set free in the circulation.

Mercury may be introduced into the organism by three routes:—

I. Through the skin: (*a*) by inunction; (*b*) by fumigation.

II. Under the skin by hypodermic injection.

III. Through the intestinal canal.

It is eliminated by the kidneys, intestinal glands, and by the mucous membrane of the mouth and salivary glands.

Its excretion is slow and especially so if the insoluble preparations are used, and mercury can be demonstrated in the urine several months after its administration has been discontinued.

It is no doubt true that the long-continued presence of mercury in the organism plays an important part in producing its effect, but to get the most benefit from it it is necessary not to give it continuously, but with interruptions, as formulated by Fournier and now generally adopted by syphilographers under the name of the "chronic intermittent treatment."

While it has not yet been proven, still it is by no means improbable that the continued administration of mercury has an effect upon the spirochætæ, in establishing a tolerance to the drug, so that the same moderate doses which were effective in the beginning have no longer the power of destroying them.

In other words, a mercury-fast strain of spirochætæ has been produced by the continuous influence of the mercury.

After a varying quantity of mercury has been given for some time, the blood becomes saturated with it, and this is announced by the occurrence of **mercurial stomatitis,** which is ushered in by certain **prodromal symptoms:**—

(*a*) A coppery taste in the mouth.

(*b*) An increased flow of saliva.

(*c*) Slight pain on striking the teeth together.

(*d*) Slight swelling and sponginess of the gums next the teeth.

In mild cases of ptyalism the symptoms all subside in a few days if the administration of the drug is stopped; but if an excessive quantity of mercury has been introduced into the body, or if an unusual susceptibility to the action of mercury is present, the toxemia is indicated by salivation.

The stomatitis has a practical value as a sign that a sufficient quantity of mercury is being given, for if there is no reaction it demonstrates that either not a sufficient quantity of mercury is being administered or it is not being absorbed.

Care should be taken not to push the mercury beyond the point of merely "touching the gums," for if this warning sign is not heeded and the drug is continued severe salivation is caused.

In severe cases of salivation, the gums and buccal mucous membrane are greatly swollen and ulcerated. The teeth loosen and fall out, the saliva pours out from the mouth in quantities, even to the extent of several pints a day, and the breath has an intensely fetid odor.

A bad condition of the mouth and carious, broken teeth covered with tartar cause the mouth to react prematurely to the influence of mercury, and for this reason the patient should go to a dentist and have the teeth put in order before beginning treatment.

While patients are using mercury, especially by inunction, it is necessary that they should wash their mouths three or four times a day with strong alum or chlorate-of-potash water, peroxide of hydrogen, or tincture of myrrh. Hospital patients, who, as a rule, do not use the toothbrush, should brush the gums every day with a 3 per cent. solution of chromic acid.

Light cases of spongy gums may be treated by brushing them with equal parts of tincture of myrrh and tincture of iodine, followed by a mild mouth-wash.

Treatment of Salivation.—The fetor of the breath and the ulceration can be best checked by means of chlorate of potash in solution, used as a mouth-wash, and it should also be given internally in doses of 20 grains, three times a day. The pain in the gums induced by mastication can be lessened by brushing the gums with a 4 per cent. cocaine solution before eating, although in severe cases the patient should be fed upon liquid food. The excessive secretion of saliva is controlled, to some extent, by hypodermic injections of atropine. The gums should be brushed with 3 per cent. chromic acid solution, and the ulceration in the mouth touched with a 10 per cent. nitrate-of-silver solution. The elimina-

tion of the mercury may be aided by giving the patient abundance of water to drink, and causing free purgation.

In addition to noting the condition of the patient's mouth during the administration of mercury, the state of the stomach and intestines should be closely observed, for the occurrence of cramps or diarrhea shows that the limit of dosage is reached.

It is important to *examine the urine* before beginning treatment, for, even although kidney disease may be present, it is safe to administer mercury. If, however, during the course of treatment, albuminuria occurs, it is evident that the kidneys have been affected by the mercury and its administration must be stopped.

In using the inunctions, it is not infrequent that a mercurial dermatitis follows from the local irritation of the ointment, but a dermatitis may also occur when mercury is given internally.

In addition to salivation another effect of mercury is the *mercurial eczema,* which is observed more or less in every case treated by inunctions.

It occurs in the form of small red papules with a pustule at the apex, perforated by a hair, and is caused by the irritation of the follicles of the skin by the mercury. When the papules occur in quantities, that particular part of the skin should not be rubbed at the next application of the mercurial ointment, and, in general, it is better to avoid the hairy parts of the body as much as possible in using inunctions.

MODES OF ADMINISTERING MERCURY.

Inunction.—The oldest, most extensively used, and at the same time reliable and effective means of treating an ordinary case of syphilis is the method of rubbing mercurial ointment into the skin. At the same time it is generally the preferable plan to use in the presence of grave lesions threatening life or the integrity of vital organs.

The advantage of inunction is its prompt action in saturating the body with mercury, and it is possible to give three times the quantity of mercury in this way which could be given by the mouth. At the same time the stomach digestion is not interfered with, and the patient can assimilate the maximum quantity of food, and his nutrition is maintained.

The mercury, through the friction and pressure of rubbing, is pressed into the open mouths of the sebaceous follicles and sweat-ducts in the skin. It is brought gradually in contact with the blood circulating in the capillaries of the papillary layer in the skin, and is supposed to be converted into bichloride of mercury through combination with the sodium chloride in the blood. In this soluble form it is thought to pass into the general blood-circulation.

It has also been shown by Welander that evaporation of the mercury and its absorption as a vapor through the lungs play an important part in the introduction of the drug into the body.

The mercury is stored up in the follicles of the skin for a long time after the inunctions have been discontinued, and can be found eliminated by the urine many weeks after the last inunction was given.

The blue ointment, or unguentum hydrargyrum, is the best preparation to use, and it is preferable to have it made after the formulary of the German pharmacopeia, which contains 20 grains of metallic mercury in every dram of lard. In ordinary cases 1 dram is a suitable dose, but in exceptional cases 2 drams may be used.

It is well to have the druggist measure out the daily dose of ointment and enclose it in waxed paper. In very recent times a substitute for the lard, termed *resorbin,* has been used with satisfaction. Resorbin is an emulsion made from almond oil, wax, glue, or soap solution, sometimes combined with lanolin. The advantages over the lard which resorbin possesses are, that it mixes with water, dries quickly, is less dirty, its odor is less unpleasant, and it leaves less deposit on the skin. Resorbin takes the place of lard in the blue ointment in the same proportion.

℞ Mercury ..... 1 part
Resorbin ..... 2 parts

The ointment should be thoroughly rubbed into the skin, selecting a fresh portion of the surface of the body for each day's rubbing, and it is not practicable for the patient to rub himself, but the inunction should be made by an attendant, or *masseur,* who to protect himself from salivation should wear a leather glove.

It requires from twenty to thirty minutes' firm rubbing with the hand to cause the complete absorption of the entire quantity of ointment used, and when the rubbing is completed the skin should not glisten with fat-globules, but have a uniform grayish color.

It is also desirable to make the inunctions in a regular course, as follows:—

First day: In the calves.
Second day: Inner and outer sides of the thigh.
Third day: Chest and abdomen.
Fourth day: Flexor surfaces of the arms.
Fifth day: Back.

On the sixth day the patient takes a warm bath with soap, and on the seventh day begins again with another course of rubbings.

The absorption of the mercury takes place partly by inhalation, and for that reason the patient should wear woolen underclothes, which are

changed once a week, when the bath is taken, and to get the benefit of the absorption by inhalation the rubbings should be made at night, just before going to bed.

Such a course as outlined above comprises a "tour," and in the average 5 tours, or 30 inunctions, covering a period of five weeks' time, constitute a course. Occasionally it is necessary to give more than 30 inunctions—40, or even 50, depending on the special indications.

The inunctions should be used in both secondary and tertiary periods whenever danger threatens a vital organ, such as the eye, brain, larynx, etc., and also in obstinate ulcerative processes with rapid destruction of tissue.

Fumigations of calomel are a useful *adjunct* to other treatment in the cases of early lesions which are extensive and have a tendency to involve the deeper structures, ulcerate, and extend. The calomel fumes come directly in contact with the lesions, and the local action of the vapor of mercury facilitates their healing.

Method of Application.—The patient sits on a cane-bottomed chair with a blanket around his neck, falling to the floor and surrounding him in a sort of tent. The head is left uncovered. A tin pan holding boiling water is placed under the chair, and the patient steamed for fifteen minutes. The pan is then withdrawn and 30 grains of calomel are fumigated on a tin stand, over a spirit-lamp placed underneath the chair, and the patient is allowed to remain surrounded by the fumes for half an hour. The fumigation should be employed once a day, until the gums are touched.

Sublimate baths are employed in the same class of cases, viz.: extensive, ulcerating, suppurating lesions. The intact skin does not permit a trace of sublimate in solution to be absorbed, but absorption can take place through solutions of continuity.

Intramuscular Injections.—The practice of treating syphilis by hypodermic injections of mercury was first introduced by Lewin, formerly chief of the syphilitic service in the Charité, in Berlin.

The salts used are *soluble* and *insoluble*.

Of the **soluble salts,** corrosive sublimate is preferred in the Charité because it is rapidly absorbed and has an intense action.

The solution contains 1 per cent. of corrosive sublimate, with the addition of 3 per cent. of common salt, which is added empirically, to lessen the pain and danger of causing infiltration in the muscles.

It is the practice in the Charité to give from 15 to 20 injections in all, using 2 c.c., or 30 minims, every second day.

The injections are made with an ordinary hypodermic syringe, provided with a needle which is two inches long and with a thick

bore, and the needle is plunged directly downward into the substance of the glutei muscles.

Before injecting, the skin should be cleansed with alcohol-ether rubbed on. After inserting the needle into the muscles the syringe should be removed from the needle for a moment to make sure that a vein has not been penetrated. If this accident has occurred a flow of blood will take place through the needle. If an injection, particularly of the insoluble salts, is thrown directly into the vein, an embolus which lodges in the lungs is very liable to occur.

A great advance in the subcutaneous treatment of syphilis in recent years consists in the introduction of the **insoluble salts** of mercury. The two preparations in use today are calomel and salicylate of mercury.

The calomel is universally held to be the most active and intense in its effects, while the salicylate is milder than calomel, but stronger than the bichloride.

If calomel is selected, it may be used in an emulsion of 1 part of calomel to 10 of olive oil. Of this emulsion, 1 c.c., or 15 minims, is injected once a week, and only from 6 to 8 injections can be given without producing salivation.

As stated above, the salicylate of mercury is milder in its action and less liable to cause sudden salivation than calomel.

In ordinary cases the injection is made once a week, and from 8 to 15 injections are required to cause a disappearance of the symptoms.

℞ Hydrargyri salicylatis ..... gr. xxiij.
Lanolini ..... gr. xv.
Olei olivæ ..... ℥ccxviij.

M. Sig.: Inject 15 minims hypodermically once a week; 15 minims contain gr. iss of the salicylate of mercury.

The *advantages* of intramuscular injections are, that they act promptly and rapidly, and are quite as efficacious as inunctions. The dosage is accurate, and the injection is only made once a week when the insoluble salts are used, so that the patient is relieved from the annoyance of taking medicine or making inunctions in the intervals.

The *disadvantages* are the *pain,* which is very inconsiderable, and the slight chance of the occurrence of abscess, which seldom happens.

To show how seldom abscess occurs, the author has never seen one in his practice, either in the hospital or in private.

Infiltrations frequently occur, but they are always absorbed without suppurating.

In exceptional cases the oil has been known to form a *pulmonary embolus,* with a localized pneumonia, but recovery followed in each case.

and, if the manner of separating the syringe and needle after its introduction, to note if a vein has been punctured, is always practised, the danger of embolus is reduced to practically nothing.

Salivation may occur in a small proportion of cases, without any previous warning, after one or two injections, and, as the deposit of mercury is in the muscle, we cannot stop its absorption unless an incision is made into the muscle and the small mass of mercury removed by a curette.

As a rule, however, patients can tolerate half a dozen or more injections before the gums are touched, and an improvement in the lesions is noted after the first injection, which continues progressively under the repetition of the dose.

ADMINISTRATION OF MERCURY BY THE MOUTH.

The routine treatment of syphilis by administering mercury by the mouth is a method which should be relegated to the dustheap of antiquity.

Probably more cases of tabes and general paresis are due to the mistaken confidence reposed in the effectiveness of mercury given internally than to any other cause, and, while it is true that a good many cases of syphilis have been cured by the long-continued internal treatment, a great many others have not been able to take a sufficient quantity of mercury in this way to destroy the spirochætæ, and have developed the terrible consequences of an uncured syphilis, such as tabes or paresis, many years after the original infection.

If mercury is given by the mouth, after a certain length of time the absorptive powers of the intestinal canal often become impaired, and the mercury passes through the alimentary tract unchanged and without being absorbed. Its continuous use for a long period of time often causes anemia, emaciation, and diarrhea.

Some of the preparations of mercury used for internal administration are as follows:—

Preparations of Mercury.—*Pills of protiodide of mercury* (Lamoureux & Garnier), ⅕ grain each.

Method of Administration.—One pill is given three times a day three-fourths of an hour after eating, and every third day the dosage is increased by one pill. For example, the patient takes 3 pills for three days, and on the fourth day he takes 4 pills, and on the eighth day the dose is increased to 5 pills, and so on up to the *point of tolerance,* which is usually from 10 to 15 pills or more.

The point of tolerance is not manifested by ptyalism, except in rare instances, but by *diarrhea* and *cramps.* When these symptoms occur, the dosage is reduced to a point just short of producing cramps, and, after

the maximum dose is reached, it is maintained without reduction throughout the whole course of the disease, unless anemia, emaciation, diarrhea, or salivation is produced by it.

Mercury with Chalk (*Hydrargyrum cum Creta*).—This is a mild preparation, and is not apt to produce colic, and for that reason it may be given when the protiodide causes too much diarrhea. The method of administration is similar to that of the protiodide. It may be given in 1-grain pills and increased to the *point of tolerance,* which is manifested by either ptyalism or diarrhea.

Bichloride of Mercury.—Dose, $\frac{1}{30}$ to $\frac{1}{15}$ grain. This form of mercury is very useful, and is of particular value, given in combination with iodide of potassium, later in the disease, in the form of the so-called mixed treatment.

Tannate of Mercury.—Dose, ½ to 1 grain three times a day. This is one of the newer preparations, and it is said to have the advantage of causing very little irritation to the intestinal canal.

VALUE OF THE DIFFERENT METHODS OF ADMINISTERING MERCURY.

The relative values of the treatment by inunctions and the corrosive-sublimate intramuscular injections for the routine treatment of an ordinary case of syphilis are about equal, and the writer is in the habit of explaining the advantages and disadvantages of each to the patient, and allowing him to make his own selection, with the proviso, however, that the inunctions must be made by an attendant and not by the patient himself.

All patients should be individualized, for fat people, pregnant women, old people, and debilitated and run-down individuals do not stand injections well, and in such cases treatment by inunctions should be employed.

The injection of the insoluble salts has its own particular field of use and should not be employed in the routine treatment without some special indication.

Calomel injections are the most active and intense in their effects, and for this reason they are indicated after salvarsan has been used, to cause a softening of the encapsulations surrounding deposits of spirochætæ and set them free in the circulation, when they can be destroyed by subsequent calomel injections.

They are also useful in obstinate tertiary affections which do not heal because of frequent relapses.

Calomel injections were formerly used in malignant syphilis, but have now been supplanted by salvarsan in those conditions.

The salicylate of mercury is called for in the cases where calomel injections cause too much salivation and a milder method is demanded, and they are especially useful in the obstinate affections of the mucous membranes and palmar syphilides.

The internal treatment is most uncertain in its working, but must be used with exceptional patients who do not tolerate inunctions or injections.

Too much reliance is placed, in America, upon the treatment of syphilis by the exclusive use of internal medication, and the author believes that many cases of late tertiary lesions of the brain or nervous system would not have occurred if the patient had been subjected to several vigorous courses of treatment by inunctions or injections during the first two and a half years of the disease.

SALVARSAN.

The discovery of salvarsan by Ehrlich marks an epoch in the treatment of syphilis, and, while unfortunately the hope of destroying the disease at one blow by one or even two injections of salvarsan has not been realized in the human subject, we have now a second therapeutic resource which is equal and in some cases superior to mercury.

While in human beings a dose of salvarsan will not destroy all the spirochætæ, it has been experimentally found that in animals artificially inoculated with syphilis it is possible to destroy all of the disease excitants with one dose of salvarsan, thus accomplishing the sterilizatio magna hoped for by Ehrlich, but in the human being a dose sufficiently large in proportion to the body weight to accomplish this cannot be given without causing poisoning.

Salvarsan was discovered by Ehrlich after 605 experiments with various substances; hence the name "Ehrlich-Hata 606," by which it was originally known when first placed upon the market in December, 1910.

Salvarsan is an organic chemical compound containing 3 atoms of arsenic, and chemically known as dioxydiamidoarsenobenzol. It is put upon the market in sealed ampules containing 0.6 gram of the salt.

In form it is a yellow powder, of an acid reaction, easily soluble in water, and after a couple of hours' exposure to the air oxidizing readily, which changes its color and increases its toxic properties, thus making it necessary always to use it in a freshly made solution.

The effects of salvarsan upon the organism may be studied under three heads:—

I. As an antiparasitic, destroying the spirochætæ. The destruction of the spirillæ takes place very rapidly, and a few hours after the injection they can no longer be found in the primary lesion or in papules.

II. As affecting all the tissues of the body and increasing the nutrition, which is a notable feature of the treatment.

III. For its effect on the nerves, causing an inflammation with consequent paralysis of the cerebral nerves, especially of the eyes and ears.

Clinical Effects of Salvarsan.—After an injection of salvarsan, the spirochætæ disappear from the primary lesion in from eight to forty-eight hours, and the chancre is often healed in a week.

Mucous patches, condylomata, and secondary periostitis and iritis disappear frequently in two or three days, which is vastly more rapid than when treated by mercury.

Syphilitic roseola fades quickly, but the large and small papular syphilides as well as palmar syphilides are more resistant and heal with relative slowness.

Tertiary lesions, such as gummata in the skin and bones, disappear quickly.

In malignant syphilis the effects of salvarsan are brilliant, especially in the cases which are refractory to mercury and iodides, for this type of disease is characterized by its non-tolerance of ordinary antisyphilitic remedies.

The effects of salvarsan on tabes and paresis have also been sufficiently studied to give a fair estimate of its value. In these conditions it is logical to suppose that nothing can bring about a restitution after the nerve-cells have been destroyed by the pressure of the newly formed connective tissue. Salvarsan will not cure such degenerations. Under its use, however, the symptoms are improved and the lancinating pains and Romberg's symptoms are relieved for the time. The improvement is only temporary and the salvarsan must be again repeated. It is much safer to begin with a small dose of 0.2 gram, and if well borne use in larger doses.

In such cases mercury is of no use, but, on the contrary, decidedly harmful. Iodide of potassium, on the other hand, is, without question, helpful in conjunction with salvarsan.

Congenital syphilis has been a most fatal disease in the past, but since the use of salvarsan the mortality has been materially diminished.

Mode of Administration.—As salvarsan has been known to cause deafness and disturbances of the nervous system, which always yields to mercury if given afterward, Roscher advises using a moderate quantity of mercury before the salvarsan is given, with the object of preventing these occurrences when the patient comes for treatment in the secondary period with lesions well developed.

The subcutaneous use of salvarsan is now entirely abandoned, for after injections it remains in the subcutaneous tissues without being

absorbed and also causes, in nearly every case, a severe necrosis of the tissues, with sloughing and loss of substance.

In the Charité 20 subcutaneous injections were made with 25 per cent. of abscess formation.

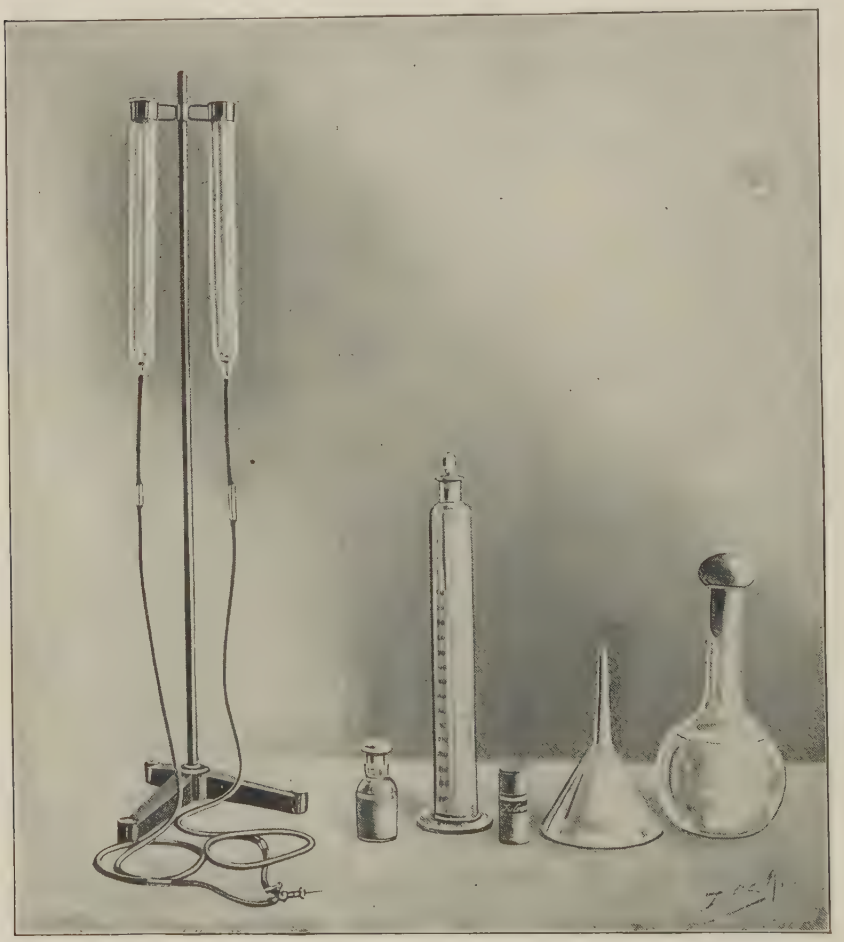


Fig. 270.—Assmy's apparatus for intravenous injection of salvarsan.

In the Long Island College Hospital we gave 2 patients salvarsan subcutaneously, and in neither case was the dose absorbed. It had no influence on the lesions and remained for weeks as a hard infiltration under the skin.

The intramuscular injections are but rarely used, and then only for some special reason, and never in acid solution, but always neutral.

The disadvantages of the intramuscular method are the intense and persistent pains which they cause, and an infiltration that lasts a long time. These infiltrations appear like an abscess forming, but they never suppurate, probably on account of the bactericidal properties of the salvarsan.

It is also possible that the deposit of salvarsan may undergo changes in the tissues and cause intoxication.

Of the preparation of salvarsan suspended in sesame oil or iodipin the writer can say nothing, as he has had no personal experience with them, but was informed by Goldbach that they had been tried in the Charité and abandoned because they did not seem to be effective; there was very little reaction, but relapses occurred frequently. As the matter stands today, the strong feeling among syphilographers is that the intravenous injection of salvarsan is the only method which deserves serious consideration.

Intravenous Injections of Salvarsan.—The most convenient form of apparatus is the one devised by Assmy, and consists of two containers, one for salvarsan and the other for salt solution.

The contents of an ampule containing 0.06 gram is put into the mixer containing 40 or 50 glass beads, normal salt solution is added, and the vessel shaken until the salvarsan is completely dissolved; 23 drops of sodium hydroxide solution are added to render the solution alkaline.

The solution is poured into one container and enough salt solution added to make 150 c.c., and the second container is filled with salt solution. All the solutions must be warm and made with distilled water which has been freshly boiled.

Wechselmann has noted that the use of freshly made salt solution was not followed by marked reaction, but that a reaction always followed the use of salt solution which was old, and he accounts for it by supposing that old solutions contain albuminous products as a result of the destruction by boiling of the organisms contained in the water.

In consequence, he always filters and boils his salt solution shortly before using, and has had less trouble from severe reactions since adopting this practice.

After sterilization of the skin with green soap, alcohol, and ether or iodine, a towel tourniquet is placed around the upper arm. The cannula is then thrust into one of the swollen veins at the bend of the elbow. That the cannula is lying within the vein is demonstrated by the flow of blood through it. Salt solution is allowed to flow through the cannula first, to make sure that the vein has not been wounded, and if no infiltration into the subcutaneous tissues occurs the salt

solution is turned off and the salvarsan allowed to flow in; 150 c.c. of the solution should take from eight to ten minutes to enter the vein.

After the salvarsan container is emptied, 10 to 20 c.c. of salt solution are allowed to flow in to carry in the rest of the salvarsan, and the needle withdrawn and the puncture dressed with gauze and adhesive plaster.

The patient is sent back to bed and kept on his back for forty-eight hours. After the lapse of this time, in nearly every case, he may be permitted to get up and walk about.

The intravenous injection of salvarsan is absolutely out of the question upon an ambulatory patient on account of the serious risk to life which he would certainly run if permitted to walk home after an injection. The use also of a hospital operating room where everything can be properly sterilized is also of the highest importance.

The intravenous injection is nearly always followed by a slight rise of temperature and sensation of a marked reaction, consisting of a chill, fever, headache, and vomiting.

In two of the writer's cases the symptoms were so marked as to be alarming, but they subsided in a few hours and nothing further developed.

Therapeutic Reactions.—Occasionally the so-called *Herxheimer reaction* is observed after salvarsan injection. This consists in a deepening and darkening of the color of the existing macules and a development of macules or papules which were previously not visible; sometimes a red zone of a darker color is noticed around the existing papules.

The Wassermann reaction sometimes becomes positive again, whereas before the injection it had been negative.

Occasionally disturbances of the central or peripheral nervous system which appear *de novo* or may consist in an increase of the pre-existing symptoms are observed, as, for example, disturbances of the cranial nerves, fatal paralysis of the pneumogastric, epileptiform convulsions in cerebral syphilis, gastric crises, lancinating pains, etc.

If the nervous system is affected, especially in cases of cerebral syphilis, great caution must be used and small doses (0.2 gram) of salvarsan be given at first, for a hyperemic swelling, resembling the Herxheimer reaction in the skin, often occurs in the brain lesion, causing dangerous cerebral pressure.

Accidents.—With a correct technique serious accidents should not occur, but with one which is faulty the patient's life may be seriously endangered. An accident which may be guarded against by the preliminary infusion of salt solution is a wound of the vein and subse-

quent leakage of salvarsan into the cellular tissue. If the vein is wounded and salt solution leaks out, the swelling is at once perceived around the vein and no harm is done, but if salvarsan leaks into the tissues it causes intense pain, inflammatory swelling, and sometimes extensive sloughing.

A thrombus which is dislodged and carried into the general circulation may occur from a solution which is too strongly alkaline or from a wound of the vein.

Carrying air into the vein from the apparatus may be guarded against by raising the rubber tubes with the stop-cock open, allowing the air to escape into the container. This precaution should never be omitted; otherwise, air-bubbles will be carried into the circulation, interfering with closure of the cardiac valves, and possibly causing sudden death.

With due regard to the above-described conditions it is possible to say that, with proper application and healthy organs, there is no danger to life. Blindness occurs very seldom, and always clears up under mercury. Deafness is very unusual, but is sometimes permanent.

The conditions in which it is dangerous to use salvarsan are aneurism and dilatation of the heart, in recent cases of myocarditis and valvular disease, when good compensation does not exist—for fear of the high temperature following the injection causing a collapse.

In brain syphilis it must be used with extreme caution; as already noted, marked diabetes, nephritis not of a syphilitic origin, advanced tuberculosis, and extreme age are all contraindications to its use.

Special Indications for Salvarsan.—1. As an abortive treatment combined with excision of the chancre when possible, and followed by an energetic course of mercurial treatment.

2. All cases of syphilis with manifest symptoms.

3. Latent syphilis with a positive Wassermann reaction.

4. Doubtful cases of tabes and general paralysis.

5. In cases where there is an idiosyncrasy against mercury and patients are too easily salivated.

6. Where mercury has had but little effect in healing lesions or when relapses take place rapidly after using.

7. In cases when after considerable mercurial treatment the Wassermann reaction still remains positive.

8. Malignant syphilis.

9. Gummata of vital organs.

10. Painful periostitis.

11. Congenital syphilis.

Elimination of Salvarsan.—Investigations as to the elimination of salvarsan show that in four or five days it is eliminated from the

blood, but that deposits of the drug are found in the glandular organs, particularly the liver, spleen, and muscles, and its elimination is still going on months after the injection has been given.

Iodide of Potassium.—The iodide of potassium has no direct action in destroying the virus of syphilis, and consequently it is of no use early in the disease. Its action is to cause the absorption of the new growth infiltrating the arteries and which, when it occurs in other tissues, is known as gumma. The iodide in small doses acts as a tonic, and increases appetite, nutrition, and tissue change.

The unpleasant effects which are induced by iodide of potassium are *coryza* and *lachrymation,* and an *eruption* upon the skin, which usually occurs upon the back, chest, and face, or small acneiform pustules. In rare cases large *bullæ* may form or the eruption may be *hemorrhagic* in character and resemble purpura.

In addition, there is often a condition of anemia, weakness, and general malaise induced. These symptoms are all less apt to occur if the kidneys secrete freely and the iodide is rapidly eliminated.

Dose and Administration.—The only rule for the size of the dose is the effect produced upon the lesion. For the ordinary routine treatment, during a period of latency, 90 or 100 grains a day are enough, but in the presence of a grave lesion of the nervous system or viscera ½ ounce, or even 1 ounce, in the day may be required to save life.

Iodide of potassium is best given in saturated solution, 1 minim of distilled water representing 1 grain of the salt. It should be given in milk or largely diluted with water, and preferably two hours after a meal, as the iodide combines with the starch in the stomach and forms iodide of starch, which is inert.

When the drug disagrees with the stomach and disturbs the digestion, it may be given in milk, which is coagulated with essence of pepsin, or the patient may be directed to drink one or two glassfuls of hot water immediately after taking the iodide.

While a small dose of iodide may cause such marked symptoms that the patient insists he cannot continue with it, it is remarkable what very large doses of the drug are generally well borne. In these cases where iodide of potassium is imperatively called for, it will be usually seen that if the dosage is rapidly increased the patient soon becomes accustomed to the drug, and the unpleasant symptoms disappear.

In very exceptional cases, salivation of a mild grade has followed the administration of iodide of potassium, and this is especially the case where mercury has been previously given, and sometimes iodide of potassium has a bad effect upon the heart, causing feebleness of its action, and blueness of the lips and extremities.

When the patient cannot tolerate iodide of potassium for any of the above reasons, *iodide of soda* can be used in its place, in doses of from 60 grains up to 300 grains.

This is a much weaker preparation, but does not affect the heart.

Iodipin is a remedy introduced into practice a few years ago, and is active and useful, but not as efficient as the iodides, and should be used only when they are not tolerated.

It may be given by the mouth in dram doses of a 10 per cent. solution, three times a day, with a few drops of aqua menth. pip. as a corrective. Its chief field of usefulness, however, is by hypodermic injection, and from 80 to 150 minims of a 25 per cent. solution should be given at a time for several days, employing the same technique as for the injection of the insoluble mercurial salts.

The iodipin forms a deposit in the tissues, from which it is slowly absorbed.

Finger summarizes its advantages as follows: 1. Complete but gradual absorption of the injected iodine. 2. Rapid disappearance of the iodism. 3. Avoidance of the intestinal disturbance, which occurs frequently with iodide of potassium. 4. Possibility of administering it to patients with cerebral syphilis who refuse to swallow. 5. Possibility of subjecting the patient to the continuous absorption of iodipin for weeks or months after a short course of injections.

Zittmann's Decoction.—This is one of the officinal preparations of the pharmacopeia, and is composed of a number of vegetable bitters, together with a minute quantity of metallic mercury. Its action is first purgative and later tonic, and in some way, which is not understood, it exercises a most beneficial effect in indolent, spreading ulcerations which do not respond to mercury and iodide of potassium. These lesions occur chiefly in malignant syphilis affecting persons of feeble vitality, who are usually of the tubercular diathesis and who cannot tolerate mercury or iodide of potassium in any considerable quantities. It is in such cases as these, says Cooper,[1] that the Zittmann treatment proves most effectual. A fortnight's treatment with this remedy will arrest the disease and will cause rapid healing and cicatrization of the lesions. The principle of the treatment consists in eliminating the poison from the system by sweating and purgation. The patient is kept in a room the temperature of which is maintained at 80° F. The evening before commencing the treatment two of the following pills are administered:—

℞ Hydrarg. chloridi mitis ..... gr. ij.
Ext. colocynthidis ..... gr. v.
Ext. hyoscyami ..... gr. ij.

[1] Alfred Cooper, Practitioner, London, July, 1904.

The diet is regulated, and for the first four days the patient drinks half a pint of the following decoction, as hot as possible, at 9, 10, and 11 A.M., and at 12 M.:—

DECOCTION I.

℞ Rad. sarsæ contus. ..... ℥iv.
Sem. anisi contus.,
Sem. fœniculi contus. .....āā ℥viiss.
Fol. sennæ ..... ℥j.
Rad. glycyrrh. contus. ..... ℥iv.

Add, in a linen bag:—

℞ Sacchar. alb.,
Alum. sulph.,
Hydrarg. chloridi mitis .....āā ℥iss.
Hydrarg. bisulph. rub. ..... ℈j.
Aquæ ..... Cong. iij.

Boil gently down to 1 gallon, strain, and put into four 40-ounce bottles.

On the same days, at 3, 4, 5, and 6 P.M., half of the following decoction, which is taken cold:—

DECOCTION II.

To the dregs from No. 1 decoction add:—

℞ Rad. sarsæ contus. ..... ℥ij.
Cort. limonis contus.,
Sem. cardamomi contus.,
Rad. glycyrrh. contus. .....āā ℥j.
Aquæ ..... Cong. iij.

Boil gently down to 1 gallon, and put into four 40-ounce bottles.

The patient is kept in bed, except for an hour every evening, when he may sit up. On the fifth day he is given a hot bath and allowed to get up. In the evening 2 pills are administered, the patient starting the decoctions again on the next day, as before. This treatment goes on in the same way until the fifteenth day, when it is discontinued.

The hot springs of Arkansas and Aachen in Germany are useful in the same class of cases, viz.: inveterate syphilis occurring in feeble individuals whose susceptibility to mercury and iodides is so extreme that they cannot be administered in sufficient doses to hold the disease under control. The water of these springs contains very little mineral substance, but has a temperature of 140° F. as it issues from the earth. Its action is to cause free secretion by the kidneys and skin, and, while it has no specific action upon the lesions of syphilis, it increases the *tolerance* of the body and enables the patient to take large doses of mercury and the iodides.

Treatment at the hot springs is unnecessary for a patient who is able to take mercury and iodide of potassium in the ordinary doses, and it is only the exceptional individual who requires to be treated at one of these resorts.

The serum treatment of syphilis has, up to the present time, been entirely without success, although many attempts have been made to produce an antisyphilitic serum.

The difficulties in the way are obvious: first, the pathological germ of syphilis has not yet been cultivated; second, the immunity of all the animals, except apes, to syphilitic infection precludes their use as mediums of cultivation.

Among the recent attempts reported at making an antisyphilitic serum are those of Risso and Cipolina,[1] who injected a number of dogs with blood obtained from patients in the secondary stage of syphilis who had never had any syphilitic treatment.

The blood of these animals was taken, and the serum was made so as to contain not only the blood-serum of the animal, but also the active principle of the corpuscles, and solid contents of the blood.

Sixteen patients were injected with the serum so prepared, and with reported improvement.

Metchnikoff's experiment may also be mentioned. He inoculated 6 apes (Makkaken) with syphilis, and no symptoms occurred, showing their immunity. He then took the serum from these apes and inoculated chimpanzees, and they also appeared to be rendered immune.

The matter at present is entirely too hypothetical to be of any value, and since the discovery of salvarsan experimentation along the lines of serum treatment has come to a standstill.

THERAPEUTICS OF SYPHILIS.

TREATMENT OF DIFFERENT STAGES.

Primary Stage.—It is now generally held by the best authorities that it is not good practice to begin the administration of mercury in syphilis until the eruption appears upon the skin, announcing the commencement of the secondary stage. If mercury is given before this time, it has only the effect of delaying the appearance of the rash, and it may be postponed for some months, but the premature administration of mercury has no effect in aborting the disease or mitigating its severity. On the other hand, it has been noted by Ehrmann that patients who were treated with mercury for some time

[1] La Riforma Medica, November 30, 1904, and Medical Record, February 4, 1905.

previous to the appearance of the eruption were more liable to tertiary affections than in the cases where treatment was not begun until the secondary period.

Another advantage which is derived from waiting till secondary manifestations appear, before beginning treatment, is that the diagnosis is fully established and the patient, being entirely convinced that he has syphilis, is more willing to carry out faithfully the details of a protracted course of treatment.

Before beginning treatment the patient should be sent to a dentist to have the teeth examined, for teeth which are broken or carious cause the mouth to react too quickly to mercury, and salivation may result.

He should also be instructed as to the **hygiene** to be maintained during the course of the disease. Everything should be done to maintain the bodily health and nutrition; plenty of sleep and exercise in the open air, abundance of plain, nutritious food, and freedom from overwork or anxiety should be insisted upon.

The use of tobacco should be interdicted, as it causes an irritation of the mucous membrane of the mouth, which predisposes to the formation of mucous patches and chronic ulceration and tends to retard their healing.

Alcoholic drinks in strict moderation may be permitted in the shape of small quantities of beer or light wine, taken preferably with the meals. The habitual use of whisky is injurious.

The patient should be instructed with regard to the danger of communicating syphilis to others, through the medium of a cup, spoon, pipe, towel, or other utensil, and by means of sexual intercourse or kissing.

Since the introduction of salvarsan the practice has changed entirely in regard to withholding constitutional treatment until the appearance of secondary manifestations, and it has been found that we can exert a powerful influence upon the disease by beginning treatment at once with an intravenous injection of salvarsan as soon as microscopic examination of the primary lesion has disclosed the spirochætæ.

It is also desirable to excise the chancre when it is located in a position where such a procedure is practicable.

It is not enough, however, to depend upon one or even two doses of salvarsan, but it must be followed by an energetic mercurial treatment, preferably calomel injections, and the prognosis of the case observed by repeated Wassermann reactions.

Dry or atrophic tubercular syphilide. (Author's case, from King's County Hospital.)

In a few cases treated in this way, a complete destruction of the spirochætæ was attained in a few weeks, as shown by the Wassermann reaction, which remained permanently negative.

While this fortunate result may only be reached occasionally, the attempt to abort the disease should be tried in every case of primary syphilis, for if it fails, no harm is done, and the patient may be treated along the usual methodic lines subsequently.

ROUTINE TREATMENT OF AN ORDINARY CASE OF SYPHILIS.

The opinion at the present time among syphilographers is that the best results in rapidly and completely destroying the spirochætæ and so curing the syphilis, are obtained by the combined use of salvarsan, mercury, and iodide of potassium.

With mercury the spirochætæ are not killed *en masse,* but are destroyed slowly and by degrees, and the natural defenses of the organism—the antibodies—are gradually brought to bear against the infection, and the patient goes more or less definitely through the various stages of the disease as would be the case if he were untreated.

Even if he relapses he has the defensive asset in the mercury he has taken already. In using salvarsan the effects are different; the great bulk of the spirochætæ are killed at once and those that remain are too few to stimulate the resistance of the body, and they begin again to multiply. When a relapse takes place, as it usually does, the body is unprepared to cope with the newly formed spirochætæ.

The advantages of the combination method are that the immediate effect of the salvarsan is to kill large numbers of the spirochætæ, while the mercury, by its superior penetrating power, softens the encapsulations and destroys the spirillæ which were in deposits in various organs out of reach of the salvarsan.

The iodide of potassium has no direct action on the virus of syphilis, but it stimulates the activity of the lymphatic system, facilitates getting rid of waste products, and also causes the absorption of any syphilitic infiltration which may have taken place in the tissues or arteries.

Having studied the effects of the three antisyphilitic remedies we are in a position to draw up a plan for putting them in use.

An additional aid in the treatment of syphilis is the application of the Wassermann reaction, since before its introduction there was no means of knowing whether a syphilis which presented no lesions was cured or only latent. This necessitated a schematic empirical treatment which was applied to all cases alike. At the present time, with the assistance of the Wassermann reaction, we stand in a position to know accurately and definitely how active a treatment is called for,

and how long it must be continued, in each individual case. This places the modern treatment upon an exact scientific basis.

The routine treatment of a case of syphilis, as it should be followed in the light of our present-day knowledge, might be roughly sketched out as follows:—

In order to prevent deafness Roscher advises beginning the treatment with mercury by using a couple of injections of sublimate or salicylate before giving salvarsan.

Following the preliminary mercurial, the salvarsan should be administered by intravenous injection, and a few days later calomel injections once a week should be employed until 6 or 8 injections have been given. Preference is given to calomel because of its activity. If in spite of the vigorous treatment the Wassermann reaction is still positive, a second intravenous injection of salvarsan should be used.

If the Wassermann reaction is negative, all treatment may be suspended for two to three months.

If after a couple of months the Wassermann becomes positive again or secondary lesions appear, a repetition of the salvarsan and mercury, or either alone or together, is called for, but the second course of treatment need not be as active as the first.

The Wassermann should be repeated three or four months later, and treatment instituted or not as the Wassermann reaction and symptoms indicate during a period of two or three years.

In this way the treatment of syphilis, instead of being conducted as formerly upon a purely empirical and arbitrary scheme, is now based upon scientific observations proving that by the effects of treatment the poison upon which the disease depends is actually neutralized.

Iodide of potassium has never been supposed to have an effect in destroying the virus of syphilis, but is only used to help the body rid itself of the newly formed round-celled infiltration deposited in the tissues as a result of the irritation of the virus and to prevent arteriosclerosis.

Its use is still called for in the late secondary and tertiary stages, and after several courses of mercury and salvarsan it is useful to give 50 grains a day for three or four weeks.

The combination treatment above described can be used in conjunction with the "chronic intermittent treatment" which is in use in the large European clinics, and which can be briefly described as follows:—

During the first year, three courses of inunctions are made, the first two consisting of from 30 to 40 inunctions, and the third of from 24 to 30. In the second year 2 courses are made, consisting of 24 to 30 inunctions each.

In the third year 1 course is made, consisting of 20 to 25 inunctions. Instead of inunctions, injections of corrosive sublimate are substituted when it is the patient's wish.

During the intervals between the inunctions no mercury is given by the mouth, nor is iodide of potassium used, unless indicated by the occurrence of a tertiary lesion, and toward the end of the course of the disease a final series of inunctions is given, when practicable.

But whether treated by mercury alone or by the combination method, the progress of the disease should be continually observed by means of the Wassermann reaction.

Whatever plan of treatment is employed, however, the general nutrition of the patient should receive the closest attention during this protracted treatment. Syphilis itself is a debilitating disease, and mercury, if administered for a long time, has the effect of causing a condition of pallor and anemia. Of course, when such an effect is induced, the mercury should be stopped and tonics given.

Tonics are usually required at some stage of the disease, to counteract the destruction of red corpuscles caused by the virus. The anemia is treated with iron, and the nervous system and general nutrition are stimulated with strychnine. Codliver oil is very valuable for the emaciation and loss of weight, and especially so if there is a complication of tuberculosis. Close attention should also be paid to the matters of fresh air, exercise, food, sleep, and freedom from anxiety.

In order to keep watch on the patient's general condition it is desirable to keep a record of his weight, and it is not a difficult matter to make frequent tests with a hemoglobinometer, to see that the normal standard of hemoglobin is maintained.

The urine should be examined every week, to make sure that the administration of mercury has not caused a nephritis.

A free elimination of the morbid products through the skin should be assisted by diaphoresis in a Turkish bath, without the cold plunge, a couple of times a week, except during the inunction courses.

Severe Form of Syphilis.—The severe cases of syphilis and malignant syphilis cannot be treated in any routine way, but each case must be handled with reference to its own peculiarities. We can say, in a general way, that it is necessary to get the patient promptly under the influence of an antisyphilitic, preferably a combination of salvarsan and mercury, and at the same time avoid disturbing the digestion, and the hygienic treatment—consisting of good food, good hygienic surroundings, sunlight, fresh air, and tonics—is imperatively demanded in these cases.

The best method of using mercury is by inunction, and next in value may be ranked the hypodermic injections. The disadvantages of giving

mercury by the mouth are that it acts more slowly, and is very apt to disturb the digestion. After the disease is under control the mercury may be given by the mouth, but inunctions should be used a couple of times a year.

In this class of cases it is necessary to begin the administration of *iodide of potassium* earlier than at the beginning of the second year, inasmuch as tertiary lesions or gummata are apt to occur precociously, even as early as the fifth or sixth month, and the iodide generally has to be used in larger doses.

In most of the cases of syphilitic affections of vital organs with the exception of brain syphilis, salvarsan may be used with great advantage and often with brilliant success, in combination with mercury and iodide of potassium.

After the syphilis has run a severe course for a few months a condition is induced which is known as the **cachexia of syphilis**, and which is characterized by extreme debility and vital depression, which have resulted in consequence of the anemia and emaciation.

If severe spreading lesions exist upon the skin and mucous membranes, the case may be properly termed *malignant syphilis*. These patients unfortunately do not bear mercury and the iodide well.

Such cases demand imperatively the use of salvarsan, and its effects are wonderful in causing the lesions to heal rapidly and improving the bodily nutrition.

Before salvarsan was known Zittmann's decoction and the baths of Aachen and the hot springs of Arkansas were the only measures available.

Grave tertiary lesions of the viscera or nervous system are liable to follow a mild attack as well as a severe one, and of course the outlook for ultimate recovery depends largely upon the general character of the patient's constitution.

With individuals of fair bodily health, in the presence of a gumma of the brain or viscera, or of endarteritis of the arteries supplying the nervous system, or indeed any of the manifold complications of the tertiary period, the dosage of the iodide should be increased rapidly up to ½ ounce, or even 1 ounce, in the day, the only rule for the quantity given being the effect produced.

The patient should be put to bed and fed on a diet consisting of milk, eggs, and broths. Mercury should be given by *inunction* until a mild ptyalism is induced, and at the same time iodide of potassium should be administered in saturated solution.

In cases of cerebral endarteritis, Browning advises nitroglycerin to cause dilatation of the arteries in the brain and improvement in the circulation.

With cerebral endarteritis or brain syphilis salvarsan is contraindicated and reliance must be placed upon inunctions of mercury and large doses of the iodides.

LOCAL TREATMENT OF LESIONS.

It has been found that the direct contact of a mercurial preparation with a local syphilitic lesion hastens its disappearance by absorption. An advantage is sometimes taken of this fact by using fumigation or bichloride baths, in addition to the regular general treatment, to accelerate the healing of extensive, widespread, ulcerating lesions of the skin.

The papular eruptions on the face are annoying and unsightly, and can be made to clear up more quickly by rubbing in an ointment of the white precipitate of mercury, or mercurial plaster may be laid over the spots. They should be always treated, because if they are neglected they are apt to leave a pigmentation upon the former site.

Mucous Patches.—If mucous patches exist in the mouth, they are always of danger to innocent people, since their secretions may be conveyed upon some utensil and be inoculated into another person. On this account we should endeavor to heal them as quickly as possible. In addition to the frequent use, by the patients, of a mouth-wash of chlorate of potash or calomel and lime water, the patches themselves should be brushed over once a day with a 1 per cent. solution of corrosive sublimate.

The acid nitrate of mercury, in the strength of 1 part to 10 or 20 of water, is also an excellent preparation to use, and it also acts brilliantly in clearing up ulcerating and infiltrated patches which often occur on the tongue in late syphilis (Sherwell).

Condylomata heal readily under the general mercurial treatment, and it is only necessary to keep them clean; cover them with a dusting powder, which absorbs their secretions, and prevent contact with other parts and chafing by means of absorbent cotton interposed.

Another very convenient way of treating them is by a mixture of calomel with salt solution. This makes a thick paste, with which the condylomata can be covered.

Frambesia of the scalp, the so-called macaroon syphilide, may be treated by using an application of the following:—

℞ Alum,
Powd. camphor,
Plumbi carbonat ..... āā partes ij.
Hydrarg. bichlor. ..... partes iv.
Spts. vini diluti,
Acidi acetici pura ..... āā partes xlv.
M. Pour off the supernatant fluid.

The thick, pasty fluid at the bottom is to be brushed on the lesions.

Ulcerating Gummata.—When the floor of a gummatous ulcer is the seat of granulations, the curette should be freely used, to cut them away; or if the membrane is necrotic, it may be encouraged to slough off under poultices or gauze compresses wet with liquor aluminii acetatis.

The healthy granulating surface may afterward be covered with iodoform gauze, or Taylor advises a mild mercurial ointment with balsam of Peru 3j to the ounce. An active internal medication must also be followed.

After the lesions are dry and infiltrated, mercurial plaster should be used as a local application.

DURATION OF TREATMENT.

When the patient first presents himself for treatment in the secondary period, his first question is: "How long will the treatment continue?"

Formerly, under mercury alone, we could answer the duration of treatment is two and a half years, but now we can be less definite in our statement of time. We can only say that we believe and hope that the combination of salvarsan with mercury will shorten the duration of the disease more than if treated with mercury alone; but as salvarsan has only been used for a little more than one year, we cannot be more definite. On account of the combination of two antiseptic remedies, we hope that tabes and brain syphilis will be less apt to occur with mercury alone.

The effects of treatment should be continually observed by the Wassermann reaction, and should only cease when the reaction becomes negative and remains so permanently, for, even though the patient be free from symptoms for many years, it is impossible to say that the syphilis is cured until we are assured by repeated examinations at intervals that the Wassermann reaction has become permanently negative.

IMPOTENCE AND STERILITY.

CHAPTER XXVII.

IMPOTENCE.

Impotence may be defined as an inability on the part of the male to copulate, either on account of a failure of the penis to become erect, or because the ejaculation of seminal fluid takes place prematurely and before the penis has entered the vagina or else does not occur at all.

The mechanism of copulation is a complicated one, and requires for its performance the co-ordinated working of both nervous and muscular systems. The function of erection is known to be under the control of a collection of nervous ganglia, situated in the lumbar enlargement of the spinal cord, which is called the **center** of **erection.** The center of erection receives nerve-filaments from the genital center in the brain, and it also receives sensory fibers from the rectum, bladder, and genitals. It also sends out nerves, the *nervi erigentes,* to the genitals, whose function is to cause a vasomotor paresis of the blood-vessels in the corpora cavernosa.

A knowledge of the distribution of these various nerves serves to explain the following facts: An erection may be provoked by the influence of the brain, if it entertains libidinous ideas, or an *inhibitory influence* may be exerted from the brain by the mental emotions of fear, disgust, or fright (psychical impotence), and vigorous mental activity has the effect of removing, for the time being, sexual desire.

Certain forms of irritation of the spinal cord, caused by myelitis, traumatism, or fracture dislocation, when the lesion is located in the cervical or upper dorsal region, are often attended with persistent and powerful erections of the penis.

Erections are also caused by peripheral irritation from the genitals, transmitted along the nerves leading to the center of erection in the cord. At this point, as a result of irritation of the genitals, the sensory impulse is converted into a motor one and reflected back again to the genitals along the *nervi erigentes.*

As common illustrations of erections from peripheral irritation may be mentioned the erections occasioned by a bladder filled with urine in the morning, prostatic enlargement, or the passage of a sound through the deep urethra.

MECHANISM OF ERECTION.

The mechanism of erection is as follows: Under the influence of the nervi erigentes a relaxation of the vascular spaces in the corpora cavernosa takes place, and they fill with blood. The penis becomes erect, hard, and elongated, because the blood is pumped into the spaces and retained there.

If the blood flowed out of the erectile tissue as fast as it came in, erection could not occur; but the swelling of the corpora cavernosa exerts a certain degree of pressure upon the veins which ordinarily conduct the outflowing blood away from the penis. The return-flow of blood is checked by the pressure on the veins, and it is retained in the spaces of the erectile tissue of the penis.

Unless the spaces of the erectile tissue be completely relaxed, a sufficient quantity of blood cannot enter them to exert pressure on the outgoing veins, and the blood flows away through them.

MECHANISM OF EJACULATION.

In a normal condition ejaculation only occurs with a fully erect penis, except during sleep.

As the spaces of the corpora cavernosa become filled with blood, the verumontanum, or colliculus seminalis, which is composed of erectile tissue, also swells and becomes erect, thus blocking the entrance to the bladder, so that urine cannot flow out.

The urethral glands secrete freely and a viscid clear drop of mucus appears at the orifice of the urethra. The object of the secretion is to cover the urethral walls bathed in acid urine and to prepare them for the reception of the semen.

The contents of the seminal vesicles are poured out through the ejaculatory ducts, until the posterior and bulbous dilatations of the urethra become filled with semen, and after these are distended contractions of the bulbocavernosus muscles occur, and the semen is ejaculated in jets from the meatus. If the force of the muscles is impaired, as in paralytic impotence, the semen is not shot out in jets, but dribbles slowly away from the meatus.

CLASSIFICATION OF FORMS OF IMPOTENCE.

I. Organic, from mechanical defects.

II. Psychical, or imaginary: 1. Complete. 2. Relative.

III. Atonic, from exhaustion of genital centers in brain and spinal cord.

IV. Symptomatic: Variety A. Irritable Impotence, from disease in urethra or adnexa. Variety B. Paralytic Impotence, from organic disease in nervous system. Variety C. Impotence due to Drugs.

ORGANIC IMPOTENCE.

In this form of impotence some physical cause, which is either congenital or acquired, renders coitus mechanically impossible. The obstacle may prevent the introduction of the penis into the vagina, or, in the absence of a urethra, while coitus can be performed, it is not possible to inject the semen into the vagina.

Among the causes of organic impotence may be mentioned such failures of development as hypospadias, epispadias, small size of the organ; or acquired deformities (such as elephantiasis and tumors), disease of the corpora cavernosa (such as syphilitic or fibroid induration), or partial destruction following wounds, and cavernitis are sometimes responsible for interference with coitus, and operate by causing a deviation or curve in the penis upon erection.

Swelling of the surrounding parts, such as hernia, scrotal tumors, or excessive corpulence, with an overhanging belly, may render insertion of the penis impossible, but the sexual desire is strong, and ejaculation occurs.

TREATMENT.

In organic impotence the treatment will be successful in so far as it is possible to remove the mechanical obstacle to copulation.

In hypospadias and epispadias a plastic operation can be performed, and, when the penis is completely inclosed by overlying tissues, a small, freely movable penis capable of intromission may be formed.

Tumors and elephantiasic growths must be removed by surgical means, and hernia and hydrocele also call for operation. An effort should be made to bring about absorption of the infiltration in the corpus spongiosum, which may be confidently expected to occur if it is syphilitic in origin.

PSYCHICAL IMPOTENCE.

We have already noted in studying the physiology of coitus the fact that the brain is capable of exerting a restraining influence over the power of erection, through the inhibitory nerves which go to the spinal center of erection. As a result of nervous excitement, the action of the inhibitory nerves from the brain is aggravated, and erection fails

at the critical moment. The influence of fear and dread are observed in the same class of patients before passing a sound.

When these individuals are lying on the table, the penis is seen to shrink and grow smaller and move in a worm-like manner, which is caused by the spasmodic contraction of the muscular fibers imbedded in the trabeculæ of the corpora cavernosa. In such cases the inhibitory nerves are stimulated by the dread of catheterism; in the same way other psychical influences stimulate the action of the inhibitory nerves, and the patient is at such moments impotent.

Various types of men are affected by the form of psychical or imaginary impotence, as follows:—

Class A.—A few strong, young, vigorous men who have led clean lives, on being married to the women of their choice, either from a state of nervous excitement or a lack of confidence in themselves, or perhaps occasionally from timidity and bashfulness, do not succeed in holding an erection long enough to perform coitus, and the erection either fails to be complete or else ejaculation occurs prematurely.

Class B.—Feeble, despondent, oversensitive individuals of weak nervous fiber who have masturbated, had an attack of gonorrhea, or have been excessive in sexual intercourse. Such persons are continually dwelling on past abuse and worrying over trifling symptoms, such as a varicocele or the normal weekly occurrence of a seminal emission, and their fears are aggravated by reading quack books.

Class C.—Men of good health and well-balanced minds may be affected by various mental emotions, such as fear, disgust, and loathing, or the departure from regular habit, all of which may induce temporary impotence.

It is no uncommon experience, when illicit intercourse is being attempted, that a fear of exposure or infection, or of disgust at some coarse remark on the part of the woman, causes a failure or sudden subsidence of the erection.

The effect of habit is seen in the cases where a man is accustomed to cohabit successfully with one woman, but fails to accomplish the act of coitus with a stranger, until he becomes accustomed to the new fields. Roubaud's case is cited as an example of this. A young man who was accustomed from the beginning of his sexual life to a certain type of woman, who was a blonde and always met him dressed in a silk gown and with shoes on, could never have coitus with any other women, unless she were also a blonde and dressed in a similar manner.

Severe and prolonged mental strain, such as occurs with students, business and professional men, sometimes brings about a condition of

general neurasthenia, one of the symptoms of which is temporary impotence.

Relative impotence is a form of psychical impotence, and is the term applied to a condition in which the man is able to copulate with certain women only, and not with others.

When this is the case between man and wife, it may be due to a mutual aversion or a lack of sexual feeling on the part of the wife, which reacts upon the man and takes away his desire, and yet the same man may be entirely potent with other women.

TREATMENT.

Before beginning treatment, it is essential to make sure that we are dealing with a case of true psychical impotence and that the impotence is not *symptomatic* of some lesion in the urethra or nervous system.

The psychical form disappears spontaneously when the mental disturbances occasioning it vanish. For instance, the death of a beloved wife or loss of fortune and business anxieties may cause temporary impotence, which disappears as time goes by or the individual's circumstances improve. In these cases the friendly advice of a physician in whom the patient has confidence is valuable.

Hypnotism may be successful in relieving this form of impotence, but, as our knowledge of influencing the mental powers in this way becomes more extended, the danger of inducing the hypnotic state and other drawbacks becomes more obvious; so that, in general, it is not desirable to employ this form of treatment.

The largest number of cases of psychical impotence occur in nervous young men who have had gonorrhea or masturbated freely, and who have read and pondered over the false and lurid accounts in quack medical advertisements, pretending to describe the evil consequences of masturbation or sexual excesses.

ATONIC IMPOTENCE.

Until within a very few years a knowledge of the effects of chronic posterior urethritis and disease of the colliculus in inducing impotence was not understood, and it was not until the invention and application of the posterior urethroscope, in studying those conditions, that a clear understanding of them was obtained.

As a result of the lack of definite knowledge, the term atonic impotence was often used in a very incorrect way to describe cases where the impotence was due to local changes in the posterior urethra, or spinal

cord, which should be properly classed under the term symptomatic impotence.

Atonic impotence is a variety of comparatively rare occurrence, and in which there is no demonstrable lesion of the nervous system or urethra. It is purely functional in character, and is dependent entirely upon a failure of the spinal center of erection, and perhaps the genital center in the brain, to respond to ordinary stimuli and cause the penis to become erect.

It should be borne in mind, however, that a condition of exhaustion of the nerve-centers is often complicated by chronic inflammatory changes in the posterior urethra, induced by a gonorrhea of long standing or sexual abuses, and this fact should not be lost sight of in carrying out the treatment.

In atonic impotence sexual desire is often present, but frequently it is absent, and, as a rule, erections do not occur at all. Sometimes, however, in mild cases, a partial erection, accompanied by premature ejaculation of semen, takes place.

The lack of erectile power is usually only one symptom of general neurasthenia, which is accompanied by its usual signs, viz.: mental symptoms, such as impairment of memory, fullness in the head, and anxiety; pains in the back and limbs, feeble heart-action, vasomotor disturbances, indigestion, constipation, etc.

These general symptoms have been described by quacks in terrifying terms, in pamphlets pretending to set forth the "evil effects of self-abuse," which have an extensive circulation among the laity.

DIAGNOSIS AND TREATMENT.

Before making a diagnosis of atonic impotence care should be taken to exclude any disease of the urethra and its adnexa or the nervous system. It is generally the case that, with old rounders and masturbators, a stricture, chronic urethritis, prostatitis, seminal vesiculitis, or beginning spinal disease is present, and the impotence is not atonic and caused by exhaustion of the nervous centers, but is secondary to and a symptom of the local structural change in urethra or spinal cord.

When all these local conditions have been excluded, however, and we are certain that we are dealing with a pure functional neurosis, the following lines of treatment may be employed:—

The indications are to build up the general health of the patient, and at the same time give complete rest to the genital centers in the brain and cord; so that their cells may have an opportunity to store up again a renewed quantity of nervous energy.

Later on, after a sufficiently long period of rest has been enjoyed, a plan of treatment should be adopted calculated to stimulate and arouse again to activity the dormant cells in the genital centers; but this should never be attempted until a sufficient period of complete repose has been afforded them.

The neurasthenia, which is usually present, requires the first attention, and the patient should be directed to make use of a light, easily assimilated diet, get plenty of sleep, and take gentle, regular exercise in the open air.

Riding on horseback and the bicycle are not to be recommended, on account of the jarring to which the perineum is subjected when these are indulged in. Sea-bathing has an excellent effect as a general tonic.

Especial stress should be laid upon the necessity for avoiding all sources of erotic excitement, such as lewd books, conversations, and theatrical displays; companionship of women, immoral or otherwise, and all attempts at sexual intercourse must be rigorously interdicted.

In the early stages of treatment, in addition to blood- and tissue-building tonics,—such as codliver oil and iron,—the spinal sedatives—bromide of potash and lupulin—are in order for the purpose of giving the necessary rest to the exhausted centers.

After this treatment has been continued for some weeks and the patient's neurasthenia has disappeared, it sometimes happens that his sexual functions are improved as well; but frequently the irritability of the genital center is still so exhausted that erections either do not occur at all or are not sufficiently vigorous, and ejaculation is premature; so that a special stimulating plan of treatment has to be adopted to arouse the activity of the cells in the genital centers.

The drugs which are supposed to be particularly useful as stimulants to the nervous centers are phosphorus and nux vomica. They may be combined in the following manner, as suggested by Gross:—

℞ Quininæ sulphatis,
Ferri sulphatis ..... āā gr. xl.
Zinci phosphidi ..... gr. ij.
Acidi arsenosi ..... gr. iss.
Strychninæ sulphatis ..... gr. ⅔.
M. et ft. pil. no. xl.
Sig.: Two pills every eight hours.

Damiana and cantharides have gained some reputation among the laity as aphrodisiacs, but damiana has little or no effect, and cantharides acts as an irritant upon the kidneys and bladder whenever taken in doses sufficiently large to act as a genital excitant.

Yohimbin, which is an alkaloid, in moderate doses (gr. $\frac{1}{10}$ t. i. d.) is said to cause prompt appearance of erections, in cases of impotence, by producing dilatation of the blood-vessels in the genital organs.

In excessive doses it may cause hallucinations, hyperemia of the skin and mucous membranes, as well as the genitals. Its action as an aphrodisiac is inconstant and often disappointing.

It was hoped that when the animal extracts were first introduced they might prove of value, but extended trials of them have only resulted in disappointment.

Electricity enjoys a high reputation in the treatment of atonic impotence. The constant current is adapted to most cases, beginning with the positive pole applied over the lumbar region and the negative pole used to stroke the penis, testicles, and perineum. The strength of the current may be gauged by the sensitiveness of the patient, and it should not be used strong enough to cause discomfort. The sittings at first should be for two or three minutes every forty-eight hours, and soon increased to five minutes daily. In obstinate cases, if erections do not occur from these applications, the positive electrode may be introduced into the rectum and a more powerful effect excited. In cases where marked anesthesia of the skin of the genitals exists the faradic current may be used with better results than the galvanic.

Cold douches, or the alternate use of cold- and hot- water douches, applied with some force to the spine daily, are of some assistance, and in the same way irrigation of the rectum with hot water through a Kemp tube may be of some service as a local stimulant to the prostatic urethra.

Local treatment of the urethra is, of course, demanded when atonic impotence is complicated by chronic inflammation of the posterior urethra (see Symptomatic Impotence); but, in cases where the posterior urethra is healthy and the difficulty is a pure neurosis, the passage of sounds and use of instillations generally increase the neurasthenia, and the patient is made worse.

The operation of ligation of the dorsal vein of the penis has been practised, with the object of retarding the return flow of blood, and so allowing the erectile tissue of the corpora cavernosa to become distended and filled up with blood, in the cases where a partial erection occurred, but where the penis almost immediately became flaccid without any discharge of semen. A few cases have been reported where this operation proved successful, but the mental effect of an operation may have been partly responsible for the good result.

After the condition of impotence has yielded to protracted and careful treatment, and the patient is again able to have erections and ejaculate normally, he should be warned against indulging too freely in sexual intercourse, for any excess in this line will be very apt to be followed by a recurrence of his former disability.

SYMPTOMATIC IMPOTENCE.

This is by far the most frequent type of impotence met with in practice. The disability is never primary, as in the other forms, but it is always dependent upon and secondary to certain structural pathological changes located in the nervous system or the urethra and its adnexa, and the inability to copulate is only one symptom of many which go to make up the clinical picture.

In symptomatic impotence erections may be completely absent, although, as the genital centers in the nervous system are not affected, sexual desire is usually present.

In many cases a partial erection of the penis takes place, and the seminal fluid is ejaculated prematurely. This form is generally spoken of as irritable impotence.

VARIETY A. IRRITABLE IMPOTENCE.

This term is derived from the fact that, on account of the irritable state of the posterior urethra, the ejaculation of semen occurs prematurely before the penis has penetrated into the vagina, and the organ, which never attained to a complete erection, becomes flaccid immediately after the discharge. Many of these cases, which are characterized at first by premature ejaculation, grow worse, and in time the power of erection disappears entirely.

Irritable impotence generally depends upon the presence of chronic posterior urethritis, and the inflammation often extends from the urethra through the ejaculatory ducts, and the prostate and seminal vesicles become affected also.

The most frequent causes of chronic posterior urethritis are: the habit of interrupted coitus or "withdrawal," masturbation, excessive sexual intercourse, various forms of sexual perversion, or an uncured posterior gonorrhea.

One of the most detrimental habits to the general health which a respectable married man can fall into, for the purpose of preventing conception, is the form of marital masturbation known as "withdrawal," or onanism. The rapidity with which the evil effects follow depend upon the individual. In a high-strung nervous man, the bad

effects are observed sooner than in one of a more phlegmatic and vigorous type; but in every case, sooner or later, the evil results follow. Masturbation and sexual excesses all act in the same way, and induce a chronic engorgement of the blood-vessels in the posterior urethra, with a swelling and enlargement of the colliculus. In course of time hyperplasia of the submucous connective tissue occurs, and the newly formed scar-tissue, pressing upon the delicate nervous structures of the verumontanum, occasions various reflex symptoms in the brain, nervous and muscular systems. The process is often further complicated by germ infection, often the *Bacillus coli,* which aggravates the existing conditions.

Instead of a chronic posterior urethritis being responsible for the reflex disturbances, an organized stricture may be present in the pendulous urethra, and if the stricture be located in the deeper portion of the canal, it interferes so much with the circulation of blood in the posterior urethra that a chronic congestion results, which disappears promptly when the stricture is treated.

TREATMENT.

To treat the symptom of irritable impotence successfully, the condition in the posterior urethra requires attention. (See Chronic Urethritis, Prostatitis, and Seminal Vesiculitis.)

If pus is present and the urine is turbid, irrigations of the urethra are indicated; and if the prostate is diseased, it must be treated by massage.

As a rule, however, most of the cases present only a condition of posterior urethritis and swelling of the colliculus, which can be readily demonstrated with the posterior urethroscope by one who is skilled in its use.

Oftentimes, perhaps in one-fourth of the cases, small polypoid vegetations are seen growing from the upper surface of the colliculus.

Applications of strong solution of nitrate of silver (grs. 50 to 100 to the ounce), removal of polypi by twisting them off with forceps, and in the most intractable cases touching the surface of the colliculus with the red-hot galvanocaustic point rapidly relieve the condition of local hyperemia and swelling; and when this is restored to the normal, the symptoms dependent upon it disappear.

The writer knows of no class of cases in genitourinary work which are as completely and promptly helped by proper treatment as those just described, but to use the posterior urethroscope successfully requires a certain technique which must be learned by practice.

VARIETY B. PARALYTIC IMPOTENCE.

In paralytic impotence erections do not take place at any time, although half-erections sometimes occur. Ejaculation does not occur at all, or else takes place without causing any sensation, and the semen is not ejected in jets, but gradually oozes from the meatus.

On examination the genitals are found withered and flaccid, and the skin of the penis is but slightly sensitive, often quite anesthetic. The sensitiveness of the urethra is diminished, and a sound may be passed with ease and without pain.

Paralytic impotence, as its name implies, is dependent upon organic cerebral or spinal disease, which causes paralysis in other parts of the body. Blows upon the back of the head are especially liable to be followed by complete impotence.

In locomotor ataxia in the early stages, there may be a condition of priapism, but as the case progresses the sexual powers decline, until finally the patient may be completely impotent. Myelitis in mild forms does not affect the sexual powers, but in severe forms a state of impotence is induced.

The prognosis in paralytic impotence is, of course, bad, and treatment, either local or general, is of little or no use.

VARIETY C. IMPOTENCE RESULTING FROM DRUGS.

Sexual power is sometimes diminished or entirely destroyed from the excessive use of certain drugs. Individuals who are addicted to the habitual and excessive use of opium, chloral, bromide of potash, and hashish are very apt, in time, to lose sexual inclination and power to copulate. Workmen who are exposed to the exhalations of certain chemicals—such as arsenic, antimony, and lead—are affected in the same way.

The influence of an excessive quantity of alcohol in reducing sexual power is a matter of common knowledge, but we are not so certain as to the effects of tobacco, although some authorities claim that tobacco has an effect in lessening both sexual inclination and capacity.

An excess of sugar in the blood, which occurs in diabetes, also causes impotence, although the individual's health and strength are apparently not deteriorated.

The treatment of impotence resulting from the use of drugs consists, of course, in removing the cause, and when this can be done the prognosis is, in general, favorable.

STERILITY.

Until recent years a condition of sterility was always thought to be due to some pathological condition on the part of the woman, which prevented conception. It is now recognized that in a small number of cases, although the man is capable of performing the sexual act, still his semen is destitute of the fecundating element, and he is sterile.

As an example of this state may be cited the case of men who have been castrated. After this operation the subjects do not become impotent at once, but for a year or two after the testicles have been removed are able to practise copulation and ejaculate a material composed of urethral mucus and secretions from Cowper's and the prostatic glands, but devoid of spermatozoa, and hence incapable of impregnating the female.

The composition of normal semen, after ejaculation, is found to consist of spermatozoa formed in the testicles and the secretions of the seminal vesicles, prostate, Cowper's glands, and the glands of the urethral mucous membrane, viz.: Morgagni's crypts and Littré's glands.

The usual quantity of semen ejaculated at one discharge is from ʒij-iv, but, if coitus is repeated frequently, the quantity becomes smaller each time, until finally only a few drops are produced with difficulty.

The essential life-giving element in semen is, of course, the spermatozoa, and the function of the other ingredients is probably to coat the urethral mucous membrane and dilute the semen.

On microscopic examination the spermatozoa present a most striking picture, showing numerous small, tadpole-shaped bodies moving actively in the field. They continue to show movements until at least twelve hours after evacuation, and will present signs of activity for forty-eight hours if sheltered from light and cold.

The semen also contains *spermatic cells,* which are supposed to be breeding-places for the spermatozoa, one of which, according to Kölliker, develops out of each nucleus of a cell. *Böttcher's* crystals are discovered on adding a few drops of 1 per cent. solution of phosphate of ammonia, and appear as variegated groups of dagger-shaped crystals. It is supposed that the organic base of the crystals exists in the secretion of the prostatic follicles, and gives the semen its characteristic odor.

Finger classifies the pathological changes in the semen which cause sterility as follows:—

I. Azoöspermia, or absence of spermatozoa.

II. Oligozoöspermia, or a marked diminution in the number of spermatozoa.

III. Necrospermia: The spermatozoa are dead and without motion.

IV. Aspermia, entire absence of semen: 1. Absolute. 2. Temporary.

I. AZOÖSPERMIA.

In this condition there is an entire absence of spermatozoa. The physical character of the semen is not distinguishable from normal; the odor, consistence, and color are unchanged, and the absence of spermatozoa can only be detected by the microscope.

Azoöspermia is, of course, the normal condition before puberty, but it is rarely found in old men, who usually are able to form a few spermatozoa.

The pathological causes which bring about this condition may be grouped as follows:—

(*a*) **Frequent seminal emissions,** either from excessive masturbation or too frequent coitus cause first a diminution in number, and, if persisted in, a complete disappearance of spermatozoa, which reappear in the semen again after a few days' rest.

(*b*) **Disturbance of the Secreting Function of the Testicle.**—This generally occurs in the acute fevers and the debility following convalescence, and, as a result, the spermatozoa disappear temporarily from the semen. In chronic diseases the same often occurs, and azoöspermia often exists in tuberculosis and in syphilis, even when the testicles are not affected.

(*c*) **Disease of the testicle,** caused by syphilis, tuberculosis, or malignant disease, if it is bilateral and destroys completely the parenchyma of the organ, interferes with the formation of spermatozoa and leads to sterility. It is necessary, however, that it should be a complete destruction, for if a small part of the secreting portion is left, spermatozoa may still be formed.

(*d*) **Absence of both testicles**—either from removal by castration, atrophy consecutive to orchitis, congenital absence, or atrophy following ectopia testis—will, of course, induce permanent and irremediable sterility.

(*e*) **Bilateral obstruction of the vas deferens** is the commonest cause of azoöspermia, and results from epididymitis, which in 90 per cent. of the cases is due to gonorrhea. Tuberculosis and syphilis are responsible for the remaining 10 per cent. The obliteration of the

vas deferens is caused by the pressure, upon the seminiferous tubes, of a mass of inflammatory scar-tissue in the tail of the epididymis, which contracts and squeezes the tubes together. Finger cites 242 cases of double epididymitis, out of which 207 suffered from azoöspermia.

(*f*) **Exposure to X-rays.**—F. Tilden Brown reports that men by their mere presence in an X-ray atmosphere, incidental to radiography or the therapeutic uses of the rays, after a period of time—as yet undetermined—will be rendered sterile. Ten individuals who have devoted more or less time to the work during the past three years—not one of whom has had any venereal disease or traumatism involving the genital tract—have been found to be the subjects of absolute azoöspermia. None of the number are conscious, however, of any change or deterioration in regard to their potency.

The treatment of azoöspermia seldom meets with much success, except in cases of syphilitic epididymitis. Here an energetic course of antisyphilitic medication will often cause absorption of the infiltration, and the testicle resumes its function.

In gonorrheal epididymitis the infiltration is hard and dense, and after it has existed some little time it is impossible to bring about its absorption. It is important, for this reason, to treat every case of gonorrheal epididymitis carefully, in order to avoid the danger of sterility. (See Epididymitis.)

On account of the impossibility of restoring the patulousness of the vasa deferentia by ordinary treatment, after they have been occluded by double epididymitis, Edward Martin[1] devised and successfully practised the operation **of anastomosis between the vas deferens and the epididymis.**

The operation consists in cutting off the vas above the obstructed point, splitting its end, and sewing the split end into an incision made in the epididymis. In other cases a lateral anastomosis is made. The technique of doing a lateral anastomosis is described by Hagner[2] as follows:—

The instruments used are the knives, scissors, forceps, and needles customarily used by the eye men. The patient is etherized and an incision is made through the skin and coverings of the epididymis, which is approached from the outer side so as not to wound the spermatic artery. The artery of the vas is pushed aside and a half-inch incision is made in the vas deferens on the level with the globus major, along its axis, care being taken to get into the lumen of the tube. A portion of the globus

[1] Trans. Amer. Urological Soc., 1909.
[2] Med. Record, Aug. 10, 1907.

major is picked up between two fine forceps and an elliptical piece removed to correspond with the incision in the vas deferens. An examination of the fluid obtained by squeezing the globus major will show spermatozoa. Four fine silver-wire sutures on curved intestinal needles are inserted, one at the upper angle of the wound joining the vas and the cut surface of the epididymis, one at the lower angle, one at the outer, and one at the inner side. When these are drawn out a perfect little

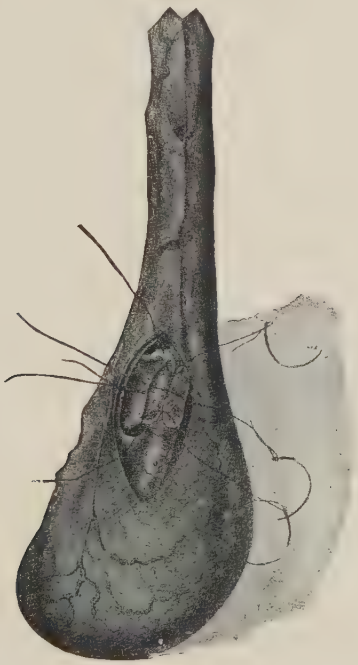


Fig. 271.—Anastomosis between the vas deferens and the head of the epididymis.

pocket is formed by the spreading out of the cut vas deferens, and the elliptically cut globus major. The wound is then closed and dressed. It will be seen that the operation is not one of grave danger to life. It is one in which the existing condition cannot be made worse, but where, in fact, everything is to be gained and nothing to be lost.

The spermatozoa may not be found immediately; sometimes as long as a month or more may elapse before they appear in the successful cases, probably on account of a temporary occlusion by hyperemia of the restored canal. Martin reports that the anastomosis operation in his hands has been followed by a reappearance of healthy spermatozoa in 6 cases, and 3 previously sterile marriages have been rendered fertile.

He also states that in the majority of cases presenting themselves because of azoöspermia the obstruction was not in the epididymis. In 2 cases there was a congenital absence of the vasa deferentia.

II. OLIGOZOOÖSPERMIA.

This condition consists in a marked diminution of the number of the spermatozoa, and may, in general, be regarded as a temporary condition, which, depending upon its cause, either returns to the normal state or goes over into complete absence of spermatozoa (azoöspermia).

Oligozoöspermia occurs normally in old age and at the beginning of puberty, and it also occurs in general debility from any disease and also after repeated acts of sexual intercourse. The most usual causes for it are gonorrheal epididymitis or new growths—either syphilis, tuberculosis, or cancer—which involve the epididymis.

As long as the vasa deferentia are not completely closed by the inflammation, a few spermatozoa may make their way through the canal. If the spermatozoa are diminished in number, and at the same time motionless, sterility is assured; but if the spermatozoa retain their movement, there is always procreative power left, but in a lessened degree.

III. NECROSPERMIA.

In this condition the male is able to copulate and to ejaculate semen, but on microscopic examination the spermatozoa are found to be dead and without motion. In order to make a valid test, it is necessary to examine the semen not later than one to two hours after ejaculation, and the specimens can only be secured by directing the man to have coitus while wearing a condom.

Necrospermia is brought about by a variety of causes which diminish the secreting capacity of the testicle. Excesses in venery or unduly frequent seminal emissions operate in this way. At first the semen is normal, but in time it becomes thinner, the numbers and motility of the spermatozoa diminish; they become small, deformed, and unripe.

The same effect is produced upon the spermatozoa by a disturbance in the nutrition of the testicle from alcoholism, morphinism, general tuberculosis, or diabetes. Various local processes—such as syphilis, carcinoma, and beginning atrophy—exert their effect upon the parenchyma of the gland, and the formation of spermatozoa is affected in consequence.

A more frequent cause of the death of the spermatozoa is some pathological alteration of the component parts of the semen. Inflammation of the seminal vesicles, either acute or chronic, causes perceptible alteration in the semen. It is usually purulent and sometimes bloody, deriving its foreign constituents from the inflamed cavities of the vesicles, and the spermatozoa are found to be dead.

The spermatozoa are also motionless in cases of chronic follicular prostatitis, for, as Fürbringer has demonstrated, the spermatozoa, so long as they are retained in the seminal vesicles, are motionless, and it requires the contact of the prostatic secretion to arouse their normal motility. When the prostatic follicles are diseased, their secretion is checked, and the spermatozoa are deprived of the stimulant necessary to excite their activity.

As already indicated, the treatment of necrospermia will depend upon the cause which occasions it, and the prognosis is good or otherwise as we are able to remove its origin.

IV. ASPERMIA.

Aspermia may be defined as a condition in which the male is able to perform coitus properly, but no semen is ejaculated into the vagina of the female, either because none is secreted or because some obstruction in the urethra prevents its passing from the meatus.

Aspermia may be either absolute or temporary, congenital or acquired.

Congenital aspermia is a very rare condition, but a few cases have been reported. Ultzmann assumed it to be due to a non-excitability of the reflex center of ejaculation. Jacobson suggests that, while the testicles are present and capable of forming spermatozoa, they cannot make their way into the urethra on account of an occlusion of the ejaculatory ducts or an absence, from anomaly of development, of a portion of the vas deferens.

Acquired aspermia is not uncommon, and is often the result of suppurative affections of the prostate brought about by gonorrhea or tuberculosis. Through the destruction of the gland and the subsequent formation of scar-tissue, the ejaculatory ducts are closed by the contraction of the cicatrix. If one duct is left open, the semen is diminished in quantity, but not noticeably so; if both ducts are closed, aspermia follows.

The ejaculatory ducts are also occasionally destroyed during a lateral lithotomy, either by being cut, in incising the posterior urethra, or by suffering laceration in dragging a large stone out of the bladder and through the wound.

The ejaculatory ducts sometimes become plugged by the formation of concretions, composed of spermatozoa, mucus, epithelial cells, and lime salts.

An insensitive condition of the glans penis may be responsible for the failure of ejaculation, and cases have been reported where an injury to the spine caused a complete anesthesia of the skin of the genitals. In another case on record the prepuce and dorsum of the penis had been destroyed by ulceration and converted into a large indurated scar, which was entirely insensitive.

One of the most frequent causes of aspermia is stricture of the urethra. On account of the swollen and turgid condition of the mucous membrane of the urethra during coitus, the orifice of a tight stricture is closed, and the seminal fluid is unable to escape past it, but is retained in the urethra behind the stricture. After the congestion subsides the verumontanum no longer closes the vesical outlet, and the semen regurgitates into the bladder, and is subsequently discharged with the urine.

Temporary aspermia is a rare condition which occurs in persons of a nervous temperament who become neurasthenic from excesses in venery, masturbation, or gonorrhea. Such individuals are usually impotent (psychical impotence), but occasionally such patients are found who can copulate, but cannot ejaculate any semen at the time, although the seminal fluid may escape a few hours later during sleep, as an emission. This form of aspermia begins suddenly, lasts a few weeks or months, and then vanishes as suddenly as it came.

The treatment of aspermia in its various forms depends upon the etiology, but the variety depending upon stricture offers a good prognosis when the urethra is restored to its normal caliber.

LIST OF GENITOURINARY INSTRUMENTS REQUIRED FOR OFFICE USE.

Urological table for cystoscopy and urethroscopy.

Valentine's irrigator.

Ultzmann's syringe.

Large metal and glass syringe, capacity 4 to 6 ozs.

Kollmann-Frank irrigating dilator for the anterior urethra.

Kollmann-Frank irrigating dilator for the posterior urethra.

Kollmann's straight dilator for the anterior urethra.

Ultzmann's brush apparatus.

Otis urethrometer.

Eighteen steel sounds, Van Buren curve. Number 16 to 34 French, inclusive, but omitting every other number.

Guyon sounds, 16 to 34 inclusive, omitting every other number.

Tunneled sounds, numbers 12, 14, 16, 18, and 20 French.

Psychrophore with Benique curve; attached to four-quart douche-bag.

Bougies à boule, metal; numbers 16 to 32 inclusive, omitting every other number.

Guyon's flexible gum-elastic bougies à boule, 16 to 30 French, omitting every other number.

One dozen whalebone guides.

Thompson's searcher for stone.

Nitze observation cystoscope with irrigation attachment for washing and filling bladder.

Nitze double-barreled catheterizing cystoscope for catheterizing ureters, with irrigation attachment.

Luy's segregator.

Urethroscope with light-carrier for anterior urethra.

Four tubes, 24, 26, 28, and 30 French.

Wossidlo's irrigation urethroscope for posterior urethra for diagnostic purposes.

Swinburne's posterior urethroscope for applications to posterior urethra.

Dry-cell battery, or transformer for street current.

Electrodes, rectal and urethral.

Needle for electrolysis of Morgagni's crypts.

Long urethral forceps.

Hypodermic syringe for injecting mercurial salts.

Catheters: Soft rubber. Silver, with prostatic curve. Woven silk coudé and bicoudé (prostatic). One Gouley tunneled silver catheter, English, with stylet. Ureter catheters.

Flexible bougies, from number 18 down to smallest.

Microscope, oil immersion, stains, etc.

Dark-field condenser, lamp, and transformer for finding spirochætæ.

PRINTED SLIPS OF INSTRUCTIONS

Given to Patients in Office and Dispensary Clinic.

INSTRUCTIONS FOR THOSE HAVING GONORRHEA.

Your disease is not a simple but a serious matter and requires great care by the doctor and strict obedience to directions by you in order to restore the organs to perfect health. It is, therefore, necessary that you do with faithfulness what the doctor orders. If you do not, it is possible that the disease will produce later in your life serious conditions which may damage your health and indeed threaten your life. Gonorrhea is a contagious disease. In order to avoid infecting other persons, and in order to prevent such complications as bubo, swollen testicles, abscess and stricture, etc., the following rules should be observed:—

Do not drink any intoxicating liquors whatever.

Do not drink any spicy soft drinks like ginger ale whatever.

Do not eat any peppery or spicy foods or pickles whatever.

Do not drink any tea, coffee, or cocoa whatever.

Do not take any violent exercise, as far as possible.

Do not indulge in any sexual excitement or sexual intercourse whatever, directly or indirectly, until pronounced cured by the physician, as the disease may be given to a woman even after the visible discharge has ceased. Moreover, sexual excitement always prolongs and aggravates the disease through the erections of the penis.

You must wash and dress the penis at least three times daily, as directed by the doctor.

You must always burn all soiled dressings.

You must always wash your hands after dressing the penis, because the discharge is blinding and may be carried to the eyes by dirty fingers.

You must sleep alone and be sure that no one else uses any of your toilet articles, particularly towels and wash cloths.

Your bowels must move once every day. If you are costive take a small dose of Rochelle salts, in hot water, before breakfast.

You must drink all the water possible, excepting during meals and up to six hours before going to bed.

You must eat chiefly milk, toast, bread, butter, and eggs, until otherwise directed by the doctor.

You must remain reasonably quiet.

You must take the medicine regularly and as directed.

You must treat Chordee by wrapping cold wet cloths about the penis after emptying the bladder. Do not try to break it, as this will cause serious injury later.

You must come for treatment with as much urine in the bladder as possible, so that the doctor may examine the urine at each visit.

You must see the doctor three times a week in order to obtain prompt and perfect cure.

You must take the hand injections in the following manner:—

1st. Always urinate *before* taking the injection.

2d. Fill the syringe, hold it tightly against the mouth of the penis, and *gently* fill the passage.

3d. Hold the injection in from five to ten minutes by the watch.

4th. Never use force in taking injections.

5th. Never use a syringe that does not work smoothly.

6th. Never use more than one syringeful at one injection, unless ordered so to do by the doctor.

7th. Never lend your syringe to anyone else, and as soon as you are well destroy it.

"Shreds" or "floaters" in the urine show that you are not yet well and are still in a condition of danger to yourself and to any woman with whom you have intercourse.

INSTRUCTIONS FOR THOSE HAVING SYPHILIS. (LUES, POX, BLOOD DISEASE.)

Syphilis is a treacherous and dangerous disease of the entire system, and requires for perfect cure, at least two, better still, three years of faithful treatment, because it is "in the blood." Healing the chancre and taking medicine for a *few weeks or months* will not cure your blood of the syphilitic poison. It is, therefore, necessary that you follow the doctor's orders most carefully. If you do not, you are in danger of having the disease appear in the future in some important part of the body like the brain, spinal cord, bones, arteries, or other organs, as the liver. If you do not follow directions it is also possible that your wife and children will acquire the disease from you.

The following directions are of particular importance during the first year and whenever, if you neglect yourself, the symptoms break out again.

Intoxicating liquors in all forms must not be taken, because alcohol is a poison which, added to the poison of the syphilis, makes the syphilis much less likely of perfect cure.

Do not smoke or chew tobacco, because the irritation of the tobacco increases the severity and duration of the mouth sores of syphilis.

Sour, acid, peppery and spicy foods and pickles should be avoided for the same reason.

Brush your teeth and wash your mouth every night and morning. Cleanliness of the teeth and mouth decreases the severity and duration of the mouth sores of syphilis.

Allow no one else to use your toothbrush.

Have a dentist treat your teeth, if they are bad. Tell him at the first visit that you have syphilis, so that he may take precautions against catching the disease himself and giving it to other patients.

To prevent giving the disease to your family, friends and associates, observe the following rules strictly:—

Always sleep alone.

Always use your own toilet articles, such as towels, brushes, combs, shaving brushes, razors, soaps, etc.

Always keep only for your own use any article which has been in your mouth, such as toothbrushes, toothpicks, pencils, pipes, cigars, cigarettes, forks, spoons, cups, etc.

Always avoid kissing anyone, especially children.

Sexual intercourse must not be had during the first year, and during any fresh outbreak after neglect of treatment, because you are then certain to give the disease to the woman.

Always burn dressings which have been on open sores or wounds.

If you disobey these directions you will certainly give the disease to innocent persons.

Rubber stamp used in office and clinic for recording findings in gonorrhea:—

URINES	I, Turbid and shreds. II, Clear.
PROSTATE	Left lobe enlarged and nodular; right, normal in size and hard.
VESICLES	Imbedded in perivesicular infiltration.
URETHRA, BULB	No. 24; stricture 2 inches from meatus.
ENDOSCOPE ANT.	Soft infiltration, going over into hard; ½ doz. crypts.
POST.	Bleeds freely; colliculus enlarged; small polyp on upper surface.
MICROSCOPE, SMEAR	Pus, squamous epithelium; moderate number of intracellular gonococci.
EXPRESSED CONTENTS OF PROSTATE AND VESICLES	Moderate amount of pus; no organisms.

Diagnosis. — Chronic gonorrhea, anteroposterior; prostatitis, perivesiculitis, and stricture.

APPENDIX.

THE importance of the microscope in the diagnosis of diseases of the genitourinary tract is so great that a short account of the methods of preparing and examining specimens of pus and urine may be of use for practitioners.

For the methods of laboratory technique the author desires to acknowledge his indebtedness to Dr. T. W. Hastings, of the Cornell Laboratory of Clinical Pathology, and Dr. A. Murray, of the Long Island College Hospital and Hoagland Laboratory.

Urethral discharges, containing gonococci or other micro-organisms, may be examined by making a thin smear with a platinum loop, on a cover-glass or slide, and submitting the smear to the following steps:—

I. Dry in the air.

II. Fix by passing the glass three times through a Bunsen flame.

III. Stain with Loeffler's solution for two to three minutes.

Saturated alcoholic solution of methylene blue	30 c.c.
Sol. potassium hydrate (1:10,000)	100 c.c.

IV. Wash in water.

V. Blot and dry.

VI. Mount in Canada balsam and examine with cedar oil and oil-immersion objective.

Loeffler's solution stains all the organisms blue, and, in order to differentiate the gonococci from other organisms, Gram's method must be used.

It is desirable to use this method of counterstaining not only to identify the gonococcus, but also to find other organisms which may be present in cases of mixed infection or of non-specific urethritis.

Gram's Method:—

I. Dry and fix.

II. Cover the preparation with the following solution and allow to stain for one minute:—

CARBOL-GENTIAN-VIOLET.

Saturated alcoholic solution, gentian-violet	10 c.c.
Carbolic acid water (2.5 per cent.)	90 c.c.

III. Pour off excess of stain and add:—

GRAM'S SOLUTION.

Iodine crystals	Gm. 1.
Potassium iodide	Gm. 2.
Distilled water	300 c.c.

Allow to act for one minute; then pour off.

IV. Decolorize in the following solution until no further trace of the stain can be washed out:—

Acetone	100 c.c.
Alcohol	300 c.c.

V. Counterstain with carbol-fushsin (Ziehl's sol.) diluted 1:10.

VI. Wash in water.

VII. Blot and dry.

VIII. Examine, if on a slide, with cedar oil placed on the slide. If on a cover-glass, mount in Canada balsam before so doing.

The Gram-*positive* organisms retain the gentian stain and remain blue or bluish black.

The Gram-*negative* organisms take counterstain and are red.

List of Gram-positive organisms remaining blue, most commonly found in genitourinary conditions:—

Tubercle bacillus.
Staphylococcus.
Streptococcus.
Smegma bacillus.

Gram-negative organisms remaining red:—

Gonococcus.
Micrococcus catarrhalis.
Bacillus coli.
Bacillus mucosus capsulatus.
Bacillus typhosus.

Prostatic secretion may be collected (*a*) in a test-tube as it oozes from the meatus after massaging the prostate.

(*b*) It may be caught on a glass slide.

(*c*) The sediment from the expression urine may be used for examination after it has been thoroughly centrifugated.

The following **scheme of examination** is useful in examining secretions in a test-tube or the sediment of the centrifugated urine, and may also be used in cases of cystitis or pyelitis when tuberculosis is suspected.

I. Examine fresh, to get a general idea of the number of cells.

II. Stain fresh secretion by adding a drop of Loeffler's solution to it, and examine at once, to gain an idea of the type of cells.

III. Dry, fix, and stain with Loeffler's solution, to find bacteria.

IV. Dry, fix, and use Gram stain, to differentiate the types of bacteria.

V. Celloidin method may be used to identify shreds of tissue.

In order to dry, fix, and stain, the prostatic secretion or centrifugated sediment of the urine may be treated as follows:—

I. Put on slide.

II. Spread with a plat loop, drying carefully over flame. Do not burn.

III. Fix by passing three times through the flame. Thorough fixing is necessary; otherwise, the secretion washes off after staining.

IV. Stain with Loeffler's solution one to two minutes.

V. Wash.

VI. Blot with filter-paper and dry.

VII. Mount in Canada balsam and cover-glass, or put a drop of cedar oil on slide and examine without a cover-glass.

Tubercle Bacilli.—In cases of suspected tuberculosis, cystitis, or pyelitis, the bacilli may, in most cases, be found by using the following methods:—

If a very small amount of sediment is present after centrifugation, the celloidin method may be used, but the following plan is applicable to most cases:—

Hansell's Method:—

I. Centrifugate the urine ten or fifteen minutes, and use all the sediment to make a thick layer on the slide.

II. Dry by heat (slowly).

III. Fix in flame.

IV. Carbol-fuchsin stain, steam for one to two minutes.

℞ Sat. alcoholic sol. basic fuchsin ..... 10 c.c.
Carbolic acid (5 per cent.) ..... 100 c.c.

V. Wash.

VI. Decolorize. Hansell's solution.

Alcohol (95 per cent.) ..... 97 parts.
Hydrochloric acid, c. p. ..... 3 parts.

Sputum decolorizes in five to ten minutes.

Urine requires half an hour.

VII. Wash.

VIII. Blot.

IX. Counterstain for one to two minutes with:—

Methyl blue, aqueous sol. (1 per cent.),
Alcohol (95 per cent.) ..... equal parts.

X. Wash, blot, dry, and examine.

Tubercle bacilli are slim, curved at one end, beaded, and in clumps of two or three, and take a **red stain.**

If there is any doubt as to the identity of the tubercle bacillus, use steps I, II, III, IV.

V. Decolorize 25 per cent. nitric or sulphuric acid three to five minutes; if red color continues, use acid until washes clear with water.

VI. Wash, and if marked color returns wash in acid again.

VII. Place in alcohol 95 per cent. eighteen to twenty-four hours.

VIII. Wash, blot, and counterstain.

To differentiate between the tubercle bacillus and the smegma bacillus **Pappenheim's method** may be used.

Use steps I, II, III, and IV as above.

V. Pour off stain without washing and cover with the following mixture:—

Corallin (rosolic acid) ..... Gm. 1.
Absolute alcohol ..... 100 c.c.
Methylene blue added to saturation.
Add glycerin (last) ..... 20 c.c.

This mixture is poured on the smear and drained off slowly four or five times and finally the preparation is washed in water. The tubercle bacilli remains bright red while the smegma bacilli are decolorized.

Kanthac's method is particularly useful in finding the tubercle bacilli when the urine contains large quantities of pus. After centrifugating the urine or allowing it to

I. Stand in a conical glass, add to the sediment five or ten times its bulk of 5 per cent. carbolic acid, depending upon amount of pus.

II. Shake hard until particles are broken up.

III. Recentrifugate, or let it stand in a conical glass for twelve hours.

IV. Examine the last few drops at the bottom of the cone.

V. Stain the drops by Hansell's method.

The method of Inoscopy may be used if much blood is present; the clot is digested with artificial gastric juice, freeing the bacilli and allowing them to sink to the bottom.

I. Centrifugate the fibrin.

II. Add to the shreds 10 to 30 c.c. of Jousset's fluid.

℞ Pepsinæ	Gm. 2.
Sodii fluoridi	Gm. 3.
Acidi hydrochlorici, Glycerini	āā 10 c.c.
Aquæ	1000 c.c.

This solution keeps indefinitely.

III. Stand in warm box or over steam radiator over night, to digest fibrin.

IV. Centrifugate and examine last drop for tubercle bacilli.

V. Stain by Hansell's method or any other.

The celloidin method is useful in examining urine containing shreds of tissue from a suspected tumor of the bladder, to determine if it is malignant or benign. It is also useful in examining the urine when tuberculosis of the bladder or kidney is thought to be present, and when but very little sediment can be obtained.

I. Slides fixed half-hour at 36° C.

II. Flood with thin celloidin (collodion thinned down to consistency of water, with alcohol and ether, equal parts).

III. Wash for a few seconds with cold tap-water.

IV. Blot and dry.

V. Alcohol, 95 per cent., five to ten minutes.

VI. Wash and dry.

VII. Stain with Delafield's hematoxylin, five to ten minutes.

VIII. Wash, stain with 1 per cent. aqueous solution of eosin, five to twenty seconds.

IX. Wash again.

X. Decolorize and dehydrate with 95 per cent. alcohol, one-half to two minutes.

XI. Absolute alcohol, one minute.

XII. Xylol, one minute.

XIII. Blot and dry.

XIV. Mount in balsam.

Spermatozoa.—In cases of sterility it is necessary to examine the semen to determine the presence or absence of spermatozoa. After massaging the seminal vesicles, spermatozoa, when present, can usually be found in the expression urine, but for a complete examination the patient should be directed to have sexual intercourse, using a condom, and the ejaculated semen contained in the condom should be examined as soon as possible.

The spermatozoa can be easily found when present. Staining brings them out more prominently. The method is as follows:—

I. Make smear, ten minutes in absolute methyl alcohol.

II. Fix for one-half to one hour in 27 to 30 per cent. alcohol.

III. Stain three to ten minutes in ½ per cent. solution of eosin in glycerin.

IV. Wash in water.

V. Examine.

The heads stain pink and the tails faint pink.

Spirochæta Pallida.—To examine for the organism of syphilis, smears should be made with a platinum loop on cover-slips, from the serum.

Serum may be obtained from the *chancre* by squeezing it or by cutting through its border with a sharp Hagedorn needle or a small lancet.

From *secondary* eruptions, the serum is obtained by scarifying or scraping their surfaces.

The serum is obtained from *mucous patches* by rubbing off the surface with gauze or alcohol.

The smear should be allowed to dry in the air and stained by one of the following methods:—

I. Schereschewsky's method.

II. Giemsa method.

III. Goldhorn's method.

IV. Nocht's method.

V. Schaudinn's method, with Loeffler flagella stain.

Schereschewsky's Method:—

I. A drop of the serum from the chancre is placed on a slide and a smear made in the same manner as when making a blood-smear.

II. Allow to dry in air.

III. Fix carefully in flame.

IV. In a clean test-tube previously rinsed with hot alcohol and then with distilled water place 10 c.c. of a 0.05 per cent. watery glycerin solution and add 13 drops of Giemsa's solution (Grübler) and mix thoroughly.

V. Heat to boiling and, if no precipitate appears, pour on the slides, allowing it to remain for three minutes.

VI. Pour off stain, rinse preparation in distilled water.

VII. Apply stain again (a third time if necessary) as above.

When sufficiently stained the fiber appears a deep pink, with a slight metallic luster when dry.

VIII. Rinse in water.

IX. Dry without heating.

X. Add a drop of cedar oil.

XI. Examine with a $\frac{1}{12}$ oil-immersion lens.

The *Spirochæta pallida* appears as an intense pink.

The *Spirochæta refringens* stains equally well, but may be distinguished by its greater thickness and by its wavy convolutions.

Giemsa method, furnished by the courtesy of Dr. Roscher, of Lesser's Clinic, Berlin:—

I. Dry in air.

II. Fix ten minutes in absolute alcohol.

III. Stain with Giemsa one and one-half hours by laying the cover-glass in a watch-glass, with the stain underneath.

IV. Wash in water.

V. Dry, mount in balsam, and examine.

The stain consists of:—

Giemsa II, eosin	3.0.
Azur II	0.8.

Mix and rub fine, and filter through gauze.

Dissolve in glycerin, *pure,* 250 grams, for one hour, at a temperature of 60° C.

After cooling add methyl alcohol (Kahlbaum I), 250 grams. Of this solution add 14 drops to 10 c.c. of water for use.

Goldhorn's Method:—

I. Use smear which is well dried, but not by heat.

II. Flood with stain for three to five seconds.

III. Pour excess of stain back into bottle: can be used again.

IV. Place slide in glass of tap-water, three to five seconds.

V. Wash by shaking in water.

VI. Drain off excess of water.

VII. Dry in air; do not blot or heat.

After staining, the slide should appear blue; if not, has been in water too long.

The *Spirochæta pallida* appears reddish purple, while the *S. refringens* is bluer in color.

Goldhorn's stain can be bought ready for use from E. Leitz & Company.

Nocht's Method:—

I. Fix smears in methyl alcohol ten minutes (or absolute alcohol twenty to thirty minutes).

II. Wash and blot.

III. Stain with mixture of the three following solutions:—

(*a*) 1 per cent. aqueous solution of eosin (water-soluble yellow).

(*b*) 1 bottle Unna's or Goldhorn's polychrome blue.

(*c*) 1 bottle aqueous methylene blue, Ehrlich's rectified.

These are for sale, put up in methyl alcohol, by E. Leitz.

They should be mixed in the following proportions:—

10 c.c. of distilled water.
2 to 3 drops of eosin solution.
5 drops of polychrome methyl blue.
2 drops of 1 per cent. aqueous methyl blue.

They should be mixed in a flat Petri dish till a fine black precipitation occurs. Make fresh before using.

IV. Place fixed slide (blood side down) in watch-glass, and leave all night to stain (twelve to eighteen hours).

V. Wash.

VI. Mount in balsam.

Examine with a 3 or 4 eye-piece and $\frac{1}{12}$ oil-immersion.

The spirochæta appears red or plum-colored.

Schaudinn's Method with Loeffler Flagella Stain.—This method is particularly valuable in studying the structure, bringing out the flagella.

I. Fix dried smear by holding slide over a solution of osmic acid 2 per cent. aqueous solution. The solution should be kept in a wide-mouthed bottle, capacity of 150 c.c., and the slide dipped in the bottle, but not immersed in the fluid: one to three seconds.

II. Flood fixed smear with following solution, two minutes:—

Tannic acid solution (20 per cent.)	100 c.c.
Cold saturated solution ferrous sulphate (1 gram in 50 c.c. of water)	50 c.c.
Sat. alcoholic solution basic fuchsin	10 c.c.

Allow the solution to stand twenty-four to forty-eight hours; open to the air to ripen.

After standing, add 6 to 8 drops of 25 per cent. sol. sodium hydroxide.

III. Wash thoroughly in water.

IV. Wash off excess of water and stain with carbol-gentian-violet two to three minutes.

Sat. alcoholic solution gentian-violet	10 c.c.
Carbolic acid (5 per cent.)	100 c.c.

V. Wash in water.

VI. Dry in air.

VII. Mount in balsam.

Spirochæta pallida takes a deep-red stain, and many show flagella at one or both ends.

INDEX.

Aberrant descent of testicle, 416
Abortive treatment of chancroid, 452
Absorbable stricture, 175
Adenitis, inguinal, 64
Alopecia, syphilitic, 490
Amboceptor, 531
Amyloid bodies in prostatic secretion, 139
Angina, specific, 490
Aniline gentian-violet, 38
Animal inoculation, 383, 395
Annular syphilides, 494
Antigen, 530
Anuria, acute septic, 200
  treatment of, 201
Ardor urinæ, 62
Arteritis, gummous, 501
Arzberg's rectal psychrophore, 144
Aspermia, 579
  acquired, 579
  congenital, 579
  temporary, 580
  treatment, 580
  varieties, 579
Aspiration, suprapubic, of bladder, 300
Atonic impotence, 567
Azoöspermia, 575
  causes, 575
  treatment, 576

Bacillus coli communis, 206
  Ducrey's, 446, 451
Bacteriology of prostatic secretion, 141
Bacteriuria, 228
  course, 228
  diagnosis, 229
  origin of bacteria, 228
  prognosis, 229
  symptoms, 228
  treatment, 229
Balanitis, 62
Balanoposthitis, 9
  diagnosis, 10
  etiology, 9
  symptoms, 9
  treatment, 10
Bath, Sitz, 215
Baths, sublimate, 541
Beard's clamp, 4
Beck's operation for hypospadias, 6
Bevan's operation, 419
Bier's hyperemia, 72
Bilharzia hæmatobia, 264
  etiology, 264
Bilharzia hæmatobia, symptoms, 265
  treatment, 265
Bladder, carcinoma, 231
  curettage, 220
  paralysis, 194
  perineal drainage, 219
Böttcher's crystals, 99, 126, 140, 574
Bottini's operation, 338
  after-treatment, 340
  mortality, 341
  results, 341
  selection of cases for, 340
  technique, 339
Bougie, flexible bulbous, 83
  for diagnosing stricture, 165
Brenner cystoscope, 267
Bubo, 458
  course of, 459
  d'Embleé, 460
  diagnosis, 460
    from syphilitic adenopathy, 460
  etiology, 459
  treatment, 460
    indications, 460

Calculus, preputial, 1
  renal, 369
    diagnosis, 372
      by X-ray, 376
    etiology, 369
    prognosis, 374
    symptoms, 370
    treatment, 375
  vesical, 242
    classification, 242
    composition, 242
    cystoscopy for diagnosing, 275
    diagnosis, 248
    etiology, 246
    mulberry, 242
    number of, 242
    operations for, in children, 264
    oxalic, 242
    phosphatic, 242
    predisposing causes of, 246
      etiology, 247
    prophylaxis, 251
    sounding for, 249
    spontaneous fracture of, 244, 252
    symptoms, 249
    treatment, 251
      operative, 252
      preventive, 251
    uratic, 242
      predisposing causes, 246

Calomel fumigations, 538, 542
Cancer of penis, 14
amputation of penis for, 17, 19
course, 15
diagnosis, 16
etiology, 14
mode of onset, 14
prognosis, 16
treatment, 17
Carbol-gentian-violet, 38
Carcinoma of bladder, 231
of prostate, 345
Castration, 427
for hypertrophied prostate, 304
indications, 427
Catarrhal prostatitis, 127
Catheter, Pezzer, 301
Catheterization, continuous, 301
ureteral, 270, 395
Celloidin method of imbedding tissues, 589
Chancre, 478
course, 478
definition, 478
diagnosis, 483
by confrontation, 484
from chancroid, 484
dry papular, 482
duration, 483
excision, 487
healing, 483
Hunterian, 482
parchment, 482
pathology, 480
prognosis, 485
synonyms, 478
transmission of contagion, 479
treatment, 486
vaccination, 479
varieties, 482
Chancroid, 446
cauterization, 453
contraindications, 453
characteristics, 448, 449
complications, 455
course, 448
development, 448
diagnosis, 451, 484
etiology, 446
frequency, 447
modes of contagion, 448
of frenum, 456
paraphimosis complicating, 457
phagedena complicating, 457
phimosis complicating, 455
stages, 450
subpreputial, 455
treatment, 455
symptoms, 449
synonyms, 446
treatment, 452
abortive, 452
methodic, 453
Chetwood's operation, 341
Choc en retour, 514
Chordee, 34, 64
treatment, 65
Chromocystoscopy, 385
Circinate syphilides, 494
Circumcision, 3
by Beard's clamp, 4
by dorsal incision, 3
Clamp, Beard's, 4
Clap-shreds, 36
Colic, renal, 370
treatment, 375
Colle's law, 513
Colliculitis, 102
Combined prostatectomy, 303
Communicating hydrocele of cord, 437
Complement, 532
Compressor urethræ, 24
Concretions, phosphatic, 140
preputial, 1
Condylomata, 12
of syphilis, 490, 517
treatment, 561
Confrontation, diagnosis of chancre by, 484
Continuous dilatation of stricture, 176
Cowperitis, 64
Cryoscopy, 385
Cryptorchism, 416
treatment, 418
Crystals, Böttcher's, 99, 126, 140, 574
Curettage of bladder, 220
Curettement of testicle, 426
Cut-off muscles, 24
Cystitis, 205
acute, 209
pathology, 209
symptoms, 213
treatment, 215, 217
chronic, 209
indications for local treatment, 217
pathology, 209
symptoms, 213
treatment, 217
classification, 209
diagnosis, 213
etiology, 205
exciting causes, 206
gonorrheal, 222
membranous, 210
micro-organisms found, 206
mode of entrance, 207
pathology, 209
predisposing causes, 205
preventive treatment, 214
prognosis, 214
simple, 209
specific, 222
suppurative, 209
symptoms, 212
tuberculous, 222
course, 223

Cystitis, tuberculous, diagnosis, 224
drainage of bladder for, 227
modes of infection, 222
pathology, 223
primary, 222
prognosis, 225
secondary, 222
symptoms, 223
treatment, 225
Cystoscope, Brenner, 267
contraindications to use, 269
for ureteral catheterizing, 268
Kelly, 267
Nitze-Leiter, 267
Nitze observation, 267
types, 267
with prisms, 267
Cystoscopy, 266, 395
contraindications, 269
in acute cystitis, 271
technique, 269
Cystotomy, 239, 302, 341, 342

Dark-field illumination, 472
Decapsulation of kidney, 409
contraindications, 412
history, 409
indications, 412, 414
results, 414
technique, 413
Dilatation of posterior urethra, 100
Dilator, urethral, 90, 173
Dittel's operation, 132
Divulsion, for stricture, 180
Doyen's operation, 436
Drainage, perineal, of bladder, 219
Dry papular chancre, 482
Ducrey's bacillus, 446, 451
Dupuytren's operation for hypospadias, 5

Ectopy of testicle, 416. (See "Testicle.")
Edema, indurative, 482
sclerotic, 482
Ejaculation, mechanism of, 564
Enuresis, 277
etiology, 277
treatment, 278
Epididymectomy, 427
Epididymitis, gonorrheal, 65
symptoms, 65
treatment, 66
Erasion of testicle, 426
Erection, center of, 563
mechanism of, 564
Expression urine test, 96
Extravasation of urine, 191
treatment, 192

False passage, 170
treatment, 170
Filiform whalebone guides, use of, 166
Fistula, perineo-urethral, 189
Flexible bulbous bougie, 83, 165
Floating kidney, 354
Folliculitis, 64
Foreign body in urethra, 194, 196
Frambesia of scalp, 561
Fumigations of calomel, 538, 542
Fungus testis in malignant diseases, 421
in tuberculosis, 423
Fürbringer's hooks, 95

Galloping consumption of testicle, 424
Giemsa stain for spirochæta pallida, 472, 591
Gleet, 76
Goldhorn's stain for spirochæta pallida, 592
Gonococci, 37
cultures, 142
morphology, 37
staining, 37
Gonococcus vaccine, 74
Gonorrhea, 31
acute, 31
résumé of treatment, 60
astringent injections, 46
causes of retarded recovery, 39
chordee, 34, 64, 65
consequences, if uncured, 120
course, 34
duration, 38
examination of pus, 36
healing of lesions, 33
incubation period, 31
pathology, 31
potassium permanganate irrigations, 50
prodromal symptoms, 34
prophylaxis, 39
relapses, 33
small round-celled infiltration, 32
treatment, 40
abortive, 41
expectant, 41
methodic, 42
summary, 52
therapeutic, 42
vaccine, 74
two-glass urine test, 35
urine in, 35
use of silver salts, 45
Gonorrheal cystitis, 222
Gonorrheal rheumatism, 71
clinical forms, 72
treatment, 72
Gradual dilatation of stricture, 177
Gram-negative organisms, 586
Gram-positive organisms, 586
Gram's method of counterstaining, 585
solution, 38, 586
Gumma, 502
of skin, 503

Gumma of subcutaneous tissues, 504
pathology, 502
ulcerating, treatment, 562
Guyon's sound, 101

Hansell's method for collecting and staining tubercle bacilli, 587
Hematocele, 438
etiology, 438
of spermatic cord, 438
symptoms, 438
treatment, 438
Hemolysis, 528
Hernia testis, 423
Herpes præputialis, 452
progenitalis, 12
Herxheimer reaction, 524
Hooks, Fürbringer's, 95
Hot springs in syphilis, 554
Hunterian chancre, 482
induration, 482
Hutchinson's teeth, 518
triad, 520
Hydrocele,
acute, 430
etiology, 430
pathology, 430
symptoms, 430
termination, 430
treatment, 431
acute purulent, 431
treatment, 432
chronic, 432
diagnosis, 433
incision of sac for, 435
pathology, 432
symptoms, 433
treatment, 434
communicating, of cord, 437
congenital, 430.
of spermatic cord, 437
cystic form, 437
diffuse form, 437
treatment, 437
Hydronephrosis, 363
acquired causes, 364
congenital causes, 363
diagnosis, 365
etiology, 363
from hypertrophied prostate, 291
intermittent, 364
prognosis, 365
symptoms, 365
treatment, 366
Hyperemia, Bier's, 72
Hypernephroma, 390
diagnosis, 391
differential diagnosis, 393
pathology, 390
prognosis, 394
symptoms, 392
treatment, 394
Hypertrophied prostate. (See "Prostate.")
Hypodermic medication in syphilis, 538
Hypospadias, 5
forms, 5
operations for, 5, 6
Beck's, 6
Dupuytren, 5
Thiersch, 5

Immune body, 531
Impotence, 563
atonic, 567
diagnosis, 568
etiology, 567
treatment, 568
forms, 564
from drugs, 573
treatment, 573
irritable, 571
etiology, 571
treatment, 572
organic, 565
etiology, 565
treatment, 565
paralytic, 573.
psychical, 565
cause, 565
treatment, 567
types of men affected, 566
relative, 567
symptomatic, 571
varieties, 571
India-ink staining of spirochæta pallida, 472
Induration, Hunterian, 482
Indurative edema, 482
Inguinal adenitis, 64
Inoculation, animal, 383, 395
Inodular stricture, 162
Inoscopy method for finding tubercle bacilli, 589
Instillations of silver nitrate, 87
provocative, 142
Instructions for cases of gonorrhea, 582
for syphilitics, 583
Instruments, care of urethral, 202
list of genitourinary, for office use, 581
Internal urethrotomy, 178
Intractable stricture, 190
Intramuscular injections of mercury, 542
Inunctions, mercurial, 538, 540
Iodide of potassium in syphilis, 552
Iodipin, 553
Irritable impotence, 571
Irritation serum method of obtaining spirochæta pallida, 471

Jadassohn's expression urine test, 96
Justus's test, 524

Kanthac's method for finding tubercle bacilli, 588
Kelly cystoscope, 267
Keratitis, interstitial, 519
Kidney, decapsulation of. (See "Decapsulation.")
diseases, 354
cystoscopic examination of bladder, 395
exploratory nephrotomy, 395
history, 394
inoculation of guinea-pigs for diagnosis, 383
floating, 354
method of examination for suspected disease of, 394
movable, 354
diagnosis, 355
etiology, 354
forms, 354
prognosis, 356
symptoms, 354
treatment, 356
operations, 396
decapsulation, 409
nephrectomy, 404
nephrolithotomy, 401
nephropexy, 404
nephrotomy, 401
pyelolithotomy, 403
results of, 407
surgical, 357
tests for functional activity, 384
tuberculosis, 378
chromocystoscopy in, 385
cryoscopy in, 385
diagnosis, 383
etiology, 378
pathology, 381
phloridzin test, 384
prognosis, 388
symptoms, 382
treatment, 389
tumors, 390
Kollmann-Frank irrigating posterior dilator, 101
Kollmann's irrigating urethral dilator, 90, 173

Lateral perineal lithotomy, 260
Law, Colle's, 513
Profeta's, 512
Lecithin bodies, 139
Leucoderma syphilitica, 495
Leucoplakia, 490
Lithoplaxy, 252
contraindications, 253
in children, 264
mortality, 257
pump, 250
technique, 255
Lithotomy, lateral perineal, 260
median perineal, 259
Lithotomy, perineal, 257
after-treatment, 260
in children, 264
mortality, 260
suprapubic, 260
advantages, 261
disadvantages, 261
in children, 264
mortality, 264
technique, 261
Lubricant for urethral instruments, 202
Luy's segregator, 275

Macaroon syphilides, 561
Macular syphilides, 493
Marriage and syphilis, 515
Massage of prostate, 143
Meatus, stricture of, 8
Median perineal lithotomy, 259
Membranous cystitis, 210
Mercurial salivation, 538, 539
Mercury in syphilis, 538
modes of administering, 538, 540, 545
Metal bulb, use of, in stricture, 166
Microscope, use of, in gonorrhea, 83
Micturition prostatorrhea, 136
Movable kidney, 354. (See also "Kidney.")
Mucous patch, 490
treatment, 561

Necrospermia, 578
causes, 578
treatment, 579
Nephrectomy, 356, 363, 369, 404
results of, 408
Nephrolithotomy, 376, 401
results, 408
Nephropexy (See "Nephrorrhaphy")
Nephrorrhaphy, 356, 404, 405
Obalinski's, 406
results, 408
Nephrotomy, 363, 401
exploratory, 395
results, 408
Neurasthenia, sexual, 94, 98
Nicolle's modification of Gram's stain, 38
Nitze-Leiter cystoscope, 267
Nocht's staining for spirochæta pallida, 592
Noguchi test, 533
Non-absorbable stricture, 175

Obalinski's nephropexy, 406
Oberlaender's urethral dilator, 90, 173
Oligozoöspermia, 578
Organic stricture, 160
Osteochondritis, syphilitic, 517
Osteophyte, 518
Otis urethrometer, 83, 166

Papillomata, 13
diagnosis, 13
of bladder, 229
of urethra, 112
treatment, 13
Pappenheim's method for finding tubercle bacilli, 588
Papular syphilides, 494, 561
Papule, dry, 482
Papulopustular syphilides, 494
Papulosquamous syphilides, 494
Paralysis of bladder, 194
Paraphimosis, 63
complicating chancroid, 457
Parchment chancre, 482
Parenchymatous prostatitis, 128
Penis amputation, 17, 19
cancer, 14
Peracute urethritis, 62
Perineal cystotomy, 341
drainage of bladder, 219
lithotomy, 257
prostatectomy, 327
prostatotomy, 302
Perineo-urethral fistula, 189
Pezzer catheter, 301
Phagedena, 457
diagnosis, 458
etiology, 457
treatment, 458
varieties, 457
Phenolsulphonphthalein test of renal function, 306
Phimosis, 1, 63
circumcision, 3
complicating chancroid, 455
results, 1, 2
treatment, 2
varieties, 1
Phloridzin test for functional activity of kidneys, 384
Phosphatic concretions, 140
Pigmentary syphilides, 495
Potassium permanganate irrigations in gonorrhea, 50
Preputial calculus, 1
concretions, 1
Profeta's law, 512
Prostate, anatomy, 124
carcinoma, 345
complicating hypertrophied, 284
diagnosis, 346
symptoms, 346
treatment, 348
hypertrophied, 280
adenomatous, 282
Bottini's operation for, 338
carcinoma complicating, 284
castration for, 304
changes in bladder, 287
in kidney, 291
in ureters, 291
in urethra, 286
Prostate, hypertrophied, Chetwood's operation, 341
choice of operation, 343
clinical classification, 292
combined prostatectomy, 303
complications, 293
cystoscopic examination, 274
cystotomy, 302, 341
diabetes complicating, 344
diagnosis, 294
etiology, 280
fibroid, 281
history of operations for, 302
obstruction to urethra from, 284
operative treatment, 302
palliative operations, 302, 341
pathology, 280
perineal cystotomy, 341
prostatectomy, 327
prostatotomy, 302
prostatectomy, 309
prostatotomy, 302
radical operations, 302
residual urine as therapeutic indication, 296
size of prostate, 284
suprapubic cystotomy, 342
prostatectomy, 320
prostatotomy, 302
symptoms, 291
treatment, 296, 302
varieties, 281
vasectomy, 304
White's classification of patients with, 343
massage, 143
secretion, 125
examination of, 586
senile hypertrophy, 280. (See also "hypertrophied," above.)
tuberculosis, 349
diagnosis, 351
etiology, 349
modes of infection, 349
pathology, 350
prognosis, 352
symptoms, 351
treatment, 352
Prostatectomy, 309
by external urethrotomy, 311
after-treatment, 316
technique, 311
forms of, 310
history, 302
late complications, 308
mortality, 310
causes, 307
perineal, 327
after-treatment, 336
mortality, 310
results, 338
technique, 328
preliminary treatment, 305

Prostatectomy, suprapubic, 320
accidents during, 326
after-treatment, 326
mortality, 307
results, 338
technique, 322
Prostatic utriculus, 26
Prostatitis, acute, 126
diagnosis, 131
etiology, 126
forms, 127
treatment, 132
catarrhal, 127
course, 127
pathology, 127
symptoms, 127
chronic, 134
complications, 137
diagnosis, 138
microscopic examination of prostatic fluid in, 139
pathology, 135
prognosis, 142
symptoms, 135
treatment, 142
parenchymatous, 128
pathology, 128
suppurative, 130
course, 130
diagnosis, 132
operations, 132
symptoms, 130
treatment, 132, 134
Prostatorrhea, 98, 136
defecation, 136
micturition, 136
Prostatotomy, 302
Psoriasis mucosæ urethræ, 112
Psychical impotence, 565
Psychrophore, use of, 144
Pustular syphilides, 494
Pyelitis, 357
ascending infection in, 357
course, 358
etiology, 357
hematogenous infection in, 357
pathology, 357
predisposing causes, 357
prognosis, 361
symptoms, 358
treatment, 362
operative, 362
Pyelography, 377
Pyelolithotomy, 403
Pyelonephritis, 357
Pyonephrosis, 357, 366
diagnosis, 367
etiology, 366
prognosis, 368
symptoms, 367
treatment, 368
Radiography, renal, 376, 395
Reaction, Wassermann, 523, 528
Recontraction of stricture, 188
Rectal examination, technique, 155
Relapsing syphilides, 496
Relative impotence, 567
Renal calculus. (See "Calculus.")
colic. (See "Colic.")
function, test of, 306, 384
radiography, 376, 395
Residual urine, 164, 288, 296
definition, 164
quantity, 164
treatment, 296
Retention of urine, 62, 192
causes, 192
treatment, 195
Rheumatism, gonorrheal, 71
Rubber stamps for record keeping, 584
Rupial syphilides, 504

Salivation, mercurial, 539
prodromal symptoms, 538
treatment, 539
Salvarsan, 546
accidents from using, 550
clinical effects, 547
effect of, on human organism, 546
on Wassermann reaction, 537
elimination, 551
modes of administering, 547
intramuscular, 548
intravenous, 549
subcutaneous, 547
special indications, 551
therapeutic reaction following, 550
Schaudinn's staining for spirochæta pallida, 593
Sclerotic edema, 482
Scrotum, tumors of, 444
diagnosis, 444
exploratory aspiration, 445
varieties, 444
Segregation of urine, 275
Segregator, Luy's, 275
Semen, 574
composition, 574
Seminal vesiculotomy, 157
vesiculitis. (See "Vesiculitis.")
Serpiginous syphilides, 505
Serum treatment of syphilis, 532, 555
Sexual neurasthenia, 94, 98
Sitz bath, 215
Sheep's red blood-corpuscle suspension, 532
Snuffles, 517
Soft stricture, 162
Sound, effect of passing, 89, 173
technique for passing, 171
Spasmodic stricture, 160
Spermatorrhea, 99, 136
Spermatozoa, 574
collection of, for examination, 590

Spermatozoa, in prostatic fluid, 141
Spirochæta pallida, 465
demonstration of living, 471
discovery, 465
dissemination of, through lymphatic system, 477
methods of examining for, 471, 590
mode of increase, 475
morphology, 465
occurrence, 466
refringens, 465
Staphylococcus pyogenes aureus, 207
Sterility, 574
causes, 574
Stomatitis, mercurial, 538
Streptococcus pyogenes, 207
Stricture, absorbable, 175
at meatus, 8
causes, 8, 189
meatotomy for, 8
cicatricial, 162
complicated by false passage, 189
continuous dilatation of, 176
divulsion for, 180
inodular, 162
intractable, 190
non-absorbable, 175
of small caliber, 176
treatment, 176, 180
operations, 177
organic, of urethra, 160
changes caused by, 163, 164
definition, 160
diagnosis, 165
etiology, 160
external urethrotomy for, 181
formation of fistula, 151
internal urethrotomy for, 178
location, 163
number, 162
pathology, 161, 163
relapses in, 175, 188
residual urine in, 164
surgical treatment, 177
symptoms, 164
treatment, 168
varieties, 162
partial resection of urethra for, 190
recent, 162
treatment, 168
recontraction, 188
results of, 163
soft, 162
treatment, 168
spasmodic, 160
etiology, 160
Sublimate baths, 542
Subpreputial chancroid, 455
Suction methods of obtaining spirochæta pallida, 471
Suppurative prostatitis, 130
Suprapubic aspiration of bladder, 300
cystotomy, 239
Suprapubic lithotomy, 260
prostatectomy, 320
prostatotomy, 302
Surgical kidney, 357
Syphilides, 491
annular, 494
circinate, 494
classification, 493
distribution, 496
early, 496
macaroon, treatment of, 561
macular, 493
synonyms, 493
microscopic appearance, 491
papular, 494
treatment, 561
papulopustular, 494
papulosquamous, 494
pigmentary, 495
pustular, 494
relapsing, 496
retrogressive changes in, 497
rupial, 504
serpiginous, 505
tertiary, 504
tubercular, 504
atrophic, 504
dry, 504
ulcerative, 505
Syphilis, 463
abortion of, 487
analogy of, to eruptive fevers, 473
and marriage, 515
condylomata, 490, 517
congenital, 469
experimental, 463
fetal, 512
length of time after chancre when danger of is past, 514
glandular enlargement in, 476
histopathology of, 468
immunity in, 510
passive, 510
incubation period, 474, 476
primary, 476
secondary, 476
inherited, 512
course, 516
diagnosis, 518
etiology, 512
symptoms, 516, 517
treatment, 520
irritation as determining location of eruptions in, 505
latent, 475
malignant, 506
symptoms, 506
marriage and, 515
mercury in, 538-546
Noguchi test, 532
primary, 468, 475, 478
prognosis, 525
prophylaxis, 486

Syphilis, salvarsan in, 546-552
secondary, 468, 476
course, 496
duration, 498
lesions, 490
prodromal symptoms, 489
skin eruptions, 491
symptoms, 498
stages, 475
tertiary, 469, 476, 499
arterial changes in, 500
gumma, 502. (See also "Gumma.")
pathology, 500
skin eruptions, 504
transmission of contagion, 479
treatment, 538
by iodide of potassium, 552
by mercury, 540
by salvarsan, 546
duration, 562
in primary stage, 555
in secondary stage, 557
in tertiary stage, 560
in the hot springs of Arkansas and Aachen, 554
local, of lesions, 561
of severe form, 559
routine, 557
serum, 555
Wassermann test, 523, 528
Syphilitic tubercle, 503

Teeth, Hutchinson's, 518
Tertiary syphilides. (See "Syphilides.")
syphilis. (See "Syphilis.")
Test, expression urine, 96
for functional activity of kidneys, 384
Justus, 524
Noguchi, 533
patient's serum, 532
phloridzin, 384
two-glass urine, 35
urea, 384
Wassermann, 523, 528
Testicle, carcinoma, 421
curettement, 426
ectopy, 416
classification, 416
complications, 418
crurofemoral, 416
diagnosis, 418
etiology, 416
inguinal, 416, 419
intra-abdominal, 416, 418
perineal, 416
results, 416
treatment of, 418
erasion, 426
galloping consumption of, 424
malignant disease of, 420
classification of, 421
clinical history in, 421
Testicle, malignant disease of, prognosis, 421
symptoms, 421
treatment, 421
sarcoma, 421
syphilis, 428
course, 428
diagnosis, 428
forms, 428
prognosis, 429
symptoms, 428
treatment, 429
tuberculosis, 422
course, 422
diagnosis, 425
galloping, 424
modes of infection, 422
prognosis, 426
symptoms, 425
treatment, 426
Thiersch's operation for hypospadias, 5
Thompson's searcher, 249
Triad, Hutchinson's, 520
Tubercle bacilli, examination for, 586
syphilitic, 503
Tuberculosis of bladder. (See "Cystitis.")
of kidney. (See "Kidney.")
of prostate. (See "Prostate.")
of testicle. (See "Testicle.")
Tumors of bladder, 229
benign, 229
classification, 229
cystoscopy in, 274
diagnosis, 235
etiology, 229
malignant, 231
mode of extension, 232
symptoms, 233
treatment, 236
of kidney, 390
of scrotum, 444
Two-glass urine test, 35

Ulcer of bladder, 266
Ultzmann-Brush apparatus, 86
Urea test for functional activity of kidneys, 384
Ureters, catheterization of, 270, 395
Urethra, anatomy, 22
anterior, 22
bulbous, 22
foreign body in, 194, 196
membranous, 22
pendulous, 22
physiological narrowings, 26
widenings, 27
posterior, 24
dilatation of, 100
prostatic, 24
stricture. (See "Stricture.")
Urethral discharge, examination of, 585

Urethritis, acute, 28
varieties, 28
anterior, 42
aseptic catarrhal, 28
chronic, 76
dangers of long uninterrupted treatment in, 118
diagnosis, 114
physical examination, 116
predisposing causes, 76
prognosis, 117
test for cure, 118
treatment, 119
chronic anterior, 76
clinical classification, 76
deep form, 77, 88
diagnosis, 82
mucous form, 77
pathology, 76
superficial form, 77, 85
symptoms, 81
treatment, 85, 88
chronic posterior, 94
causes, 94
diagnosis, 95
Jadassohn-Van Zeissl method for diagnosing, 96
pathology, 94
symptoms, 95, 97
treatment, 99
glandular, 92
gonorrheal. (See "Gonorrhea.")
non-gonorrheal, 28
peracute, 62
posterior, 55
diagnosis, 56
mild, 55
severe, 56
treatment, 57, 59
two-glass urine test, 56
predisposing causes, 28
pseudogonococcic, 29
simple, 28
treatment, 30
specific, 28
staphylococcic, 30
streptococcic, 30
uric acid, 28
treatment, 28
Urethrometer, Otis, 83, 66
Urethrorrhœa ex libidine, 83, 136
Urethroscope, 295
normal appearance of anterior urethra through, 105
of posterior urethra, 105
treatment of anterior urethra through, 112
of posterior urethra, 113
Urethroscopic appearance of normal urethra, 105
classification of gonorrhea, 106
findings in chronic anterior urethritis, 106
Urethroscopic findings, in chronic posterior urethritis, 110
Urethroscopy, 104
Urethrotomy, combined external and internal, 189
external, 181
after-treatment of, 187
forms of, 181
Gouley's, 181
indications for, 189
Wheelhouse's, 184
with a filiform guide, 181
without a filiform guide, 184
internal, 178
after-treatment, 179
anesthetic for, 178
control of hemorrhage in, 178
dangers of, 179, 180
indications for, 180
mortality of, 179
preparatory treatment for, 178
technique of, 178
Urinary fever, 197
acute, 197
prophylaxis, 198
symptoms, 197
treatment, 199
chronic, 198
symptoms, 198
treatment, 199
etiology, 197
forms of, 197
Urine, extravasation of, 191, 192
residual. (See "Residual.")
segregation of, 275
Urobacillus liquefaciens septicus, 207
Utriculus, prostatic, 26

Vaccination chancre, 479
Vaccine in cystitis, 217
gonococcus, 74
Varicocele, 440
diagnosis, 442
etiology, 440
symptoms, 440
treatment, 442
Vasectomy, 304
Venereal warts, 12
Vesiculitis, acute seminal, 146
diagnosis, 147
symptoms, 146
treatment, 148
atonic, 150, 151
chronic seminal, 149
diagnosis, 154
etiology, 153
symptoms, 154
treatment, 156
varieties, 150
inflammatory, 150
forms, 152
tuberculous, 158
origin, 158

Vesiculitis, tuberculous, symptoms, 159
treatment, 159
Vesiculotomy, seminal, 157
Volkmann's operation for hydrocele, 435
washing the bladder for, 220
solutions for, 221
Von Bergmann's operation for hydrocele, 436

Wassermann test, 523, 528
clinical application, 534
diagnostic value, 535
effect of salvarsan on, 537
Wassermann test, effect of treatment on, 536
history, 528
phenomena of hemolysis, 528
reagents for, 530
technique, 532
Whalebone guides, 166
White's classification of hypertrophied prostate, 343

X-ray for diagnosing renal calculus, 376

Yohimbin for impotence, 570

Zittmann's decoction, 553

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